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I thank all the reviewers and Associate Editors – Andy Bennett, Neil Carter, and Jeff Skevington – for their careful reviews and seeing acceptable mss through the review process. In this day and age it is not always easy to find those willing to take time from their own busy schedules to provide careful and thoughtful reviews that improve the quality of articles submitted to JESO. For many years Martin Damus has provided a cover illustration that reflects an insect treated in one of the articles. This year it is the Oriental Chestnut Gall Wasp. It finally arrived in Canada in 2012 and is reported here—38 years after it was first found in the US. Jess Vickruck has again done an excellent job as Technical Editor. These dedicated people have greatly improved the quality of articles published in JESO. It is a pleasure to work with them.

The Entomological Society of Ontario celebrates its 150th annual meeting next year. Please consider JESO milestone volume 144 as a good venue to publish your research, especially if you plan to present a talk about it at the special anniversary meeting in Guelph. If you do want to publish in JESO, please consult the recently updated "Instructions to Authors" on the website.

Many of the new electronic journals aimed at biologists and promoted almost weekly in emails received by all and sundry advertise a quick turn around time from ms submission to publication. Their editors perhaps forget that if their journal articles are to be of high quality referees must be given sufficient time to review submissions properly, (assuming that willing referees who know the subject can even be found). If turn around time is too short many potential referees will simply refuse to provide reviews. Despite the electronic competition I like to think, and certainly hope, that JESO will continue to receive interesting and diverse articles for decades to come, having stood the test of time as a worthwhile entomological journal for publishing on insects in Ontario. Although JESO might be considered as not having enough impact or prestige it has a long and solid pedigree, thanks especially to the conscientious efforts of past Editors, Associate Editors and referees. Quality and reliability count for a lot, no matter how short the article or how limited in scope it may be. So choose JESO in which to publish your work.

Happy reading.

John T. Huber
Editor

OPTIMIZATION OF SYNTHETIC PHEROMONE BLEND FOR USE IN MONITORING *CHORISTONEURA ROSACEANA* (LEPIDOPTERA: TORTRICIDAE) IN NIAGARA PENINSULA, ONTARIO, APPLE ORCHARDS

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Abstract *J. ent. Soc. Ont.* 143: 3–14

Trapping experiments were carried out in Niagara peninsula, Ontario apple orchards to determine the optimum ratios of synthetic pheromone compounds for use in monitoring the obliquebanded leafroller, *Choristoneura rosaceana* (Harris) (Leptidoptera: Tortricidae). The mean total number of moths captured in traps baited with rubber stopper lures impregnated with 0.97 mg of the major compound (*Z*)-11-tetradecenyl acetate (*Z*11-14:OAc) increased 3–4-fold with the addition of 2% of the minor compound (*E*)-11-tetradecenyl acetate (*E*11-14:OAc) and increases to 4 and 8% did not change average catch. The addition of 1–8% of the minor compound (*Z*)-11-tetradecenol (*Z*11-14:OH) to lures containing 0.97 mg *Z*11-14:OAc + 2% *E*11-14:OAc did not affect average catch. There was a 3.5–3.8-fold increase in catch when 0.97 mg *Z*11-14:OAc + 2% *E*11-14:OAc + 1.5% *Z*11-14:OH was combined with 1% of the minor compound (*Z*)-11-tetradecenal (*Z*11-14:Ald). Mean trap catch declined when the relative amount of *Z*11-14:Ald was ≥4%. There was a 2.3–3.7-fold increase mean trap catch when 0.97 mg *Z*11-14:OAc + 1.5% mg *Z*11-14:OH + 1% *Z*11-14:Ald was combined with 1% *E*11-14:OAc. There was no increase in catch with additional increases in the relative amount of *E*11-14:OAc. There was a 1.8–2.3-fold decrease in catch when 2% *Z*11-14:OH was combined with 0.97 mg *Z*11-14:OAc + 2% *E*11-14:OAc + 1% *Z*11-14:Ald. There was no change in mean trap catch with the addition of greater relative amounts of *Z*11-14:OH. The results suggest that the optimum blend of synthetic pheromone compounds for use in monitoring *C. rosaceana* in the Niagara peninsula of Ontario is a blend of the main compound *Z*11-14:OAc plus the minor compounds in relative amounts of 1% *E*11-14:OAc, 0–1% *Z*11-14:OH and 1% *Z*11-14:Ald.

Published December 2012

Introduction

The obliquebanded leafroller, *Choristoneura rosaceana* (Harris) (Lepidoptera: Tortricidae), is native to North America where it is distributed throughout southern Canada and most areas of the continental United States, except the arid southwest (Chapman and Lienk 1971). The larvae of *C. rosaceana* are polyphagous, feeding on the foliage and fruit of many deciduous plants, although its primary hosts typically belong to the Rosaceae (Weires and Riedl 1991). There are one or two generations per year, depending on climate, and second- or third-instar larvae overwinter in a hibernaculum (Chapman and Lienk 1971). *Choristoneura rosaceana* is a key pest of commercial apple, *Malus domestica* (Borkh) (Rosaceae) in Ontario where sprays of insecticide are applied to control the larvae of its two annual generations (Anonymous 2009, 2010).

The sex pheromone of *C. rosaceana* consists of the major compound (*Z*)-11-tetradecenyl acetate (*Z*11-14:OAc) (Roelofs and Tette 1970) and three minor compounds, (*E*)-11-tetradecenyl acetate (*E*11-14:OAc), (*Z*)-11-tetradecenol (*Z*11-14:OH) and (*Z*)-11-tetradecenal (*Z*11-14:Ald) (Cardé et al. 1977; Hill and Roelofs 1979; Vakenti et al. 1988; El-Sayed et al. 2001*a*). It was initially believed that *Z*11-14:Ald was present only in populations from western North America (Vakenti et al. 1988; Thomson et al. 1991), but further investigation revealed that this compound was also an important component of the pheromone of some eastern North American populations of this species in Ontario and Quebec (El-Sayed et al. 2001*a*, 2003). The pheromone gland and effluvium of an Ontario population of *C. rosaceana* contained approximately 96% *Z*11-14:OAc, 2% *E*11-14:OAc, 1.5% *Z*11-14:OH and 0.5% *Z*11-14:Ald (El-Sayed et al. 2001*ab*).

Traps baited with synthetic sex pheromone are used to accurately time insecticide sprays for the control of *C. rosaceana* in Ontario apple orchards (Anonymous 2009). Sex pheromone-baited traps have also been used in Ontario to indirectly measure the effectiveness of pheromone treatments applied to control *C. rosaceana* by sex pheromone-mediated mating disruption (Trimble and Appleby 2004). Field trapping studies carried out in the Niagara peninsula of Ontario have demonstrated the behavioral activity of the minor pheromone compounds when combined with the main compound in relative amounts of 2% (*E*11-14:OAc), 1.5% (*Z*11-14:OH) and 1% (*Z*11-14:Ald) (El-Sayed et al. 2001*a*, 2003; Trimble and Marshall 2008), but it is not known if this is the optimal blend of compounds for use in this location. This paper reports the results of field trapping experiments designed to determine if the previously used blend is optimal for use in apple orchards in the Niagara peninsula of Ontario.

Materials and Methods

Synthetic pheromone

Pheromone compounds were acquired from the Pherobank, Plant Research International, Wageningen, The Netherlands. The *Z*11-14:OAc was 99.2% chemically pure and contained 0.4% *E*11-14:OAc. It did not contain the known *C. rosaceana* attraction inhibitors (*Z*)-9-tetradecenyl acetate (*Z*9-14:OAc) or (*E*)-9-tetradecenyl acetate (*E*9-

14:OAc) (Trimble and El-Sayed 2006). The *E*11-14:OAc had a chemical and isomeric purity of 99.5%. The *Z*11-14:OH and *Z*11-14:Ald had a chemical purity of 99 and 91.5%, respectively.

Field trapping experiments

A stepwise approach was used to determine the effect on trap catch of combining increasing relative amounts of minor compounds with the main pheromone compound. In the first experiment, *Z*11-14:OAc was combined with 0, 1, 2, 4 or 8% *E*11-14:OAc. In the second experiment *Z*11-14OAc + 2% *E*11-14:OAc was combined with 0–8% *Z*11-14:OH. In the third experiment *Z*11-14OAc + 2% *E*11-14:OAc + 1.5% *Z*11-14:OH was combined with 0–8% *Z*11-14:Ald. In a second set of experiments, *Z*11-14OAc + 1.5% *Z*11-14:OH + 1% *Z*11-14:Ald was combined with 0–8% *E*11-14:OAc, and *Z*11-14OAc + 2% *E*11-14:OAc + 1% *Z*11-14:Ald was combined with 0–8% *Z*11-14:OH. Trap lures were prepared by applying 200 µl of pheromone in hexane, or hexane (i.e. control), to the large "well" of 9 mm diameter, natural rubber sleeve stoppers (Chromatographic Specialties, Brockville, Ontario). The solvent was allowed to evaporate in a fume hood and the stoppers were stored at –20°C until use. Stoppers were attached to 8 mm-diameter corks using an insect pin. The corks were positioned in the middle of the insect adhesive-coated surface of 21 cm-long x 20 cm-wide x 12 cm-high white plastic delta traps (Cooper Mill Ltd., Madoc, Ontario) and the traps were positioned 1.5–2.0 m above the ground within the tree canopy.

Experiments were carried out in 0.2–2.2 ha plots of cv. Empire, McIntosh or Red Delicious insecticide-free apple trees at the Agriculture and Agri-Food Canada (AAFC) Experimental Farm at Jordan Station, Ontario (43°10′N 79°24′W) during the first and second annual *C. rosaceana* flights of 2004–2008, and during each of the two annual flights of 2010. A randomized complete block (RCB) or split-plot experimental design (Snedecor and Cochran 1989) was used to test the effect of varying the relative amounts of *E*11-14:OAc and *Z*11-14:OH (2004–2008). The location of treatments within blocks (RCB) or subplots (split-plot) was not changed during a flight period. There was ≈10 m between traps. A completely randomized design (Snedecor and Cochran 1989) was used to test the effect of varying the relative amount of *Z*11-14:Ald (2010). There was ≈20 m between traps in this experiment and the location of treatments was re-randomized at 14 d intervals. In all experiments moths were counted and removed from the traps twice each week and the rubber stopper lures were renewed at 2-wk intervals.

Analysis of data

Statistical analyses were performed using JMP® 7.0 (SAS Institute, Cary, North Carolina). The significance of the effect of the relative amount of a minor compound on the mean number of moths captured during a flight was tested using a randomized complete block, split-plot, or completely randomized analysis of variance model after transforming the data using $\sqrt{(x + 0.5)}$. The significance of differences between means was first tested using the Tukey Honestly Significant Difference (HSD) test. If there were no differences using this test the Fisher Least Significant Difference (LSD) test was used to identify differences (Dallal 2001). Means were back-transformed for presentation in tables (Snedecor and Cochran 1989).

Results

The attractiveness of lures baited with *Z*11-14:OAc was increased by the addition of *E*11-14:OAc (Table 1). There was a 3- and 4-fold increase in the mean total number of moths captured during the spring and summer flights of 2004, respectively, when 0.97 mg of *Z*11-14:OAc was combined with 0.02 mg *E*11-14:OAc (2%). There was no statistically detectable increase in trap catch when the relative amount of *E*11-14:OAc was 1%, and increases above 2% did not significantly change average catch (Table 1). The addition of *Z*11-14:OH to lures containing a blend of 0.97 mg *Z*11-14:OAc + 0.02 mg *E*11-14:OAc (2%) did not affect the mean total number of moths captured during the spring and summer flights of 2005 (Table 2). There was a 3.5- and 3.8-fold increase in the mean total number

TABLE 1. Mean ± SD total number *Choristoneura rosaceana* captured in traps baited with lures containing a constant amount of *Z*11-14:OAc and increasing amounts of *E*11-14:OAc.

Treatment	Amount of compound, mg/lure		Total number captured	
	*Z*11-14:OAc	*E*11-14:OAc	First flight	Second Flight
1	0.97	0.0	5.4±3.4b (29)	8.5±8.7b (50)
2	0.97	0.01	10.6±11.6ab (64)	22.0±30.6ab (134)
3	0.97	0.02	14.6±17.3a (89)	32.8±51.8a (211)
4	0.97	0.04	8.7±7.2ab (48)	22.3±18.1ab (123)
5	0.97	0.08	6.9±7.4ab (40)	24.5±23.2ab (147)
6	0.0	0.0	0.0±0.0c (0)	0.0±0.0c (0)

Total number trapped in parenthesis. First flight, 11 June – 9 July 2004 (n = 270), RCB ANOVA, F = 6.21, df = 5,20, P = 0.0013; Second flight, 4 August – 16 September 2004 (n = 665), RCB ANOVA, F = 6.47, df = 5,20, P = 0.001. Means within each flight followed by the same letter not significantly different (Fisher LSD test, P > 0.05).

TABLE 2. Mean ± SD total number *Choristoneura rosaceana* captured in traps baited with lures containing constant amounts of *Z*11-14:OAc and *E*11-14:OAc and increasing amounts of *Z*11-14:OH.

Treatment	Amount of compound, mg/lure			Total moths captured	
	*Z*11-14:OAc	*E*11-14:OAc	*Z*11-14:OH	First flight	Second flight
1	0.97	0.02	0.0	11.2±8.2a (61)	13.0±23.3a (374)
2	0.97	0.02	0.01	10.3±7.3a (56)	10.7±26.4a (348)
3	0.97	0.02	0.02	8.9±10.6a (52)	5.4±17.0a (193)
4	0.97	0.02	0.04	13.9±17.2a (82)	11.0±35.6a (355)
5	0.97	0.02	0.08	11.6±8.9a (63)	8.6±27.1a (283)
6	0.0	0.0	0.0	0.0±0.0b (0)	0.0±0.0b (0)

Total number trapped in parenthesis. First flight, 13 June – 11 July 2005 (n = 314), RCB ANOVA, F = 12.92, df = 5,20, P < 0.0001); Second flight, 29 July – 21 September 2005 (n = 1554), Split-plot ANOVA, F = 4.78, df = 5,60, P < 0.008. Means in a column within each flight followed by the same letter not significantly different (Fisher LSD test, P > 0.05).

of moths captured during the spring and summer flights of 2010, respectively, when a blend of 0.97 mg *Z*11-14:OAc + 0.02 mg *E*11-14:OAc (2%) + 0.015 mg *Z*11-14:OH (1.5%) was combined with 0.01 mg (1%) of *Z*11-14:Ald (Table 3). Mean trap catch declined when the relative amount of *Z*11-14:Ald was increased to 4% during the spring flight and to 8% during the summer flight. There was a 2.3- and 3.7-fold increase in the mean total number of moths captured during the spring and summer flights of 2006, respectively, when a blend of 0.97 mg *Z*11-14:OAc + 0.015 mg *Z*11-14:OH (1.5%) + 0.01 mg *Z*11-14:Ald (1%) was combined with 0.01 mg (1%) of *E*11-14:OAc (Table 4). There was no increase in mean trap catch with additional increases in the relative amount of *E*11-14:OAc. There was no change in the mean total number of moths captured during the spring and summer flights of 2007 when 0.01 mg *Z*11-14:OH (1%) was combined with a blend of 0.97 mg *Z*11-14:OAc + 0.02 mg *E*11-14:OAc (2%) + 0.01 mg *Z*11-14:Ald (1%). There was a 1.8- and 2.3-fold decrease in the mean total number of moths captured during these flights, however, when 0.02 mg *Z*11-14:OH (2%) was used in this blend (Table 5). There was no change in mean trap catch with the addition of greater relative amounts of *Z*11-14:OH.

TABLE 3. Mean ± SD total number *Choristoneura rosaceana* captured in traps baited with lures containing constant amounts of *Z*11-14:OAc, *E*11-14:OAc and *Z*11-14:OH and increasing amounts of *Z*11-14:Ald.

Treatment	Amount of compound, mg/lure				Total moths captured	
	*Z*11-14:OAc	*E*11-14:OAc	*Z*11-14:OH	*Z*11-14:Ald	First flight	Second flight
1	0.97	0.02	0.015	0.0	26.0±18.5c (113)	7.4±1.7c (30)
2	0.97	0.02	0.015	0.01	90.9±28.8ab (371)	28.2±8.3a (115)
3	0.97	0.02	0.015	0.02	95.5±34.5a (390)	18.0±1.8ab (72)
4	0.97	0.02	0.015	0.04	30.8±15.2c (128)	16.7±7.2abc (69)
5	0.97	0.02	0.015	0.08	41.3±16.2bc (170)	13.8±6.7bc (57)
6	0.0	0.0	0.0	0.0	0.8±1.2d (4)	0.4±1.0d (2)

Total number trapped in parenthesis. First flight, 27 May – 8 July 2010 (n = 1176), One-way ANOVA, F = 20.92, df = 5,18, P < 0.0001; Second flight, 27 July – 13 September 2010 (n = 345), One-way ANOVA, F = 23.40, df = 5,18, P < 0.0001. Means in a column within each flight followed by the same letter not significantly different (Tukey HSD test, P > 0.05).

Discussion

The results of this study suggest that the optimum blend of synthetic pheromone compounds for use in monitoring *C. rosaceana* in the Niagara peninsula of Ontario is a blend of the main compound *Z*11-14:OAc plus the minor compounds in relative amounts of 1% *E*11-14:OAc, 0–1% *Z*11-14:OH and 1% *Z*11-14:Ald. Traps baited only with the main compound required the addition of 2% *E*11-14:OAc to effect a significant increase in the capture of moths, but when traps were baited with the main compound and each of the three

TABLE 4. Mean ± SD total number *Choristoneura rosaceana* captured in traps baited with lures containing constant amounts of *Z*11-14:OAc, *Z*11-14:OH and *Z*11-14:Ald and increasing amounts of *E*11-14:OAc.

Treatment	Amount of compound, mg/lure				Total moths captured	
	*Z*11-14:OAc	*E*11-14:OAc	*Z*11-14:OH	*Z*11-14:Ald	First flight	Second flight
1	0.97	0.00	0.015	0.01	9.1±7.7b (51)	16.7±23.7b (105)
2	0.97	0.01	0.015	0.01	21.3±17.2a (121)	62.2±51.2a (352)
3	0.97	0.02	0.015	0.01	17.5±9.7ab (93)	53.8±33.8a (291)
4	0.97	0.04	0.015	0.01	23.0±13.6a (100)	75.8±65.7a (423)
5	0.97	0.08	0.015	0.01	12.9±7.7ab (69)	48.9±25.1a (257)
6	0.0	0.0	0.0	0.0	0.0±0.0c (0)	0.0±0.0c (0)

Total number trapped in parenthesis. First flight, 9 June – 19 July 2006 (n = 434), RCB ANOVA, F = 11.39, df = 5,20, P < 0.0001; Second flight, 31 July – 10 October 2006 (n = 1428), RCB ANOVA, F = 14.21, df = 5,20, P = 0.0001. Means in a column within each flight followed by the same letter not significantly different (Fisher LSD test, P > 0.05).

TABLE 5. Mean ± SD total number *Choristoneura rosaceana* captured in traps baited with lures containing constant amounts of *Z*11-14:OAc, *E*11-14:OAc and *Z*11-14:Ald and increasing amounts of *Z*11-14:OH.

Treatment	Amount of compound, mg/lure				Total moths captured	
	*Z*11-14:OAc	*E*11-14:OAc	*Z*11-14:OH	*Z*11-14:Ald	First flight	Second flight
1	0.97	0.02	0.0	0.01	28.5±28.7a (502)	14.7±13.4a (273)
2	0.97	0.02	0.01	0.01	22.6±18.9ab (383)	9.8±6.0ab (169)
3	0.97	0.02	0.02	0.01	15.9±19.9b (282)	6.4±4.3b (110)
4	0.97	0.02	0.04	0.01	13.0±12.9b (225)	5.2±5.9b (103)
5	0.97	0.02	0.08	0.01	15.2±10.3b (251)	8.5±7.9ab (160)
6	0.0	0.0	0.0	0.0	0.1±0.5c (2)	0.2±0.4c (4)

Total number trapped in parenthesis. First flight, 6 June – 18 July 2007 (n = 1645), Split-plot ANOVA, F = 14.90, df = 5,40, P = 0.0002; Second flight, 23 July – 3 October 2007 (n = 819), Split-plot ANOVA, F = 12.90, df = 5,40, P = 0.0004. Means in a column within each flight followed by the same letter not significantly different (Fisher LSD test, P > 0.05).

minor compounds, the inclusion of *E*11-14:OAc at 1% was sufficient to effect a significant increase in the capture of *C. rosaceana*. There was no increase in the number of moths captured with the use of greater relative amounts of *E*11-14:OAc in the complete, four-compound blend.

The results suggest that it may not be necessary to include *Z*11-14:OH in synthetic *C. rosaceana* pheromone for use in the Niagara peninsula because there was no change in the number of moths captured in traps baited with *Z*11-14:OAc plus 2% *E*11-14:OAc when *Z*11-14:OH was included at 1, 2, 4 or 8% relative to the main compound. In addition, there was no change in the number of moths captured when 1% *Z*11-14:OH was added to a blend of *Z*11-14:OAc plus relative amounts of 2% *E*11-14:OAc and 1% *Z*11-14:Ald; the addition of greater relative amounts of *Z*11-14:OH to this blend significantly reduced the number of moths captured compared to the numbers captured in traps baited with a lure that did not contain the alcohol. In another field trapping study conducted in Niagara peninsula apple orchards, Trimble and Marshall (2008) were unable to detect any increase in trap catch during three of four *C. rosaceana* flight periods when 1.5% Z11-14:OH was added to a blend of Z11-14:OAc plus 2% E11-14:Ac; however, during a fourth flight period there was a 2.2-fold increase in trap catch with the addition of the alcohol.

The pheromone gland of female *C. rosaceana* from the Niagara peninsula contained *Z*11-14:OH in amounts ranging from 1.16–2.20% relative to the main pheromone compound *Z*11-14:OAc (El-Sayed et al. 2001*ab*, 2003; El-Sayed and Trimble 2002) and the pheromone gland effluvium contained 1.75% *Z*11-14:OH relative to the main pheromone compound (El-Sayed et al. 2001*b*). In addition, the electroantennogram (EAG) response–pheromone dose relationships measured in the antennae of male *C. rosaceana* from the Niagara peninsula was similar for *Z*11-14:OAc and *Z*11-14:OH (El-Sayed et al. 2001*b*). The production and emission of *Z*11-14:OH by female *C. rosaceana*, and the ability of male antennae to detect this compound suggests that it has a role in the pheromone-mediated sexual communication of Niagara populations of this species. In a flight tunnel experiment using male *C. rosaceana* from the Niagara peninsula, there was a trend of increase in the proportion of individuals initiating the take-off, lock-on, close-in, and touchdown phases of upwind flight to *Z*11-14:OAc when *E*11-14:OAc, *Z*11-14:OH and *Z*11-14:Ald were successively added in relative amounts of 2, 1.5 and 1%, respectively (Trimble and Marshall 2008). This observation suggests that *Z*11-14:OH is important in the chemical communication of *C. rosaceana* and should be included in a blend of synthetic pheromone compounds for use in monitoring the presence and activity of this species in the Niagara peninsula.

The results of the present study confirm the behavioural activity of the minor pheromone compound *Z*11-14:Ald. There was an approximately 4-fold increase in the capture of *C. rosaceana* in traps baited with *Z*11-14:OAc plus relative amounts of 2% *E*11-14:OAc and 1.5% *Z*11-14:OH when 1% *Z*11-14:Ald is added to the blend. In previous trapping studies in Niagara peninsula apple orchards 2–3-fold increases in trap catch were observed after the addition of 1% of the aldehyde compound (El-Sayed et al. 2001*a*, 2003; Trimble and Marshall 2008).

The significance of differences between the mean numbers of *C. rosaceana* captured in traps baited with different blends of pheromone was tested using both the Tukey HSD test and the Fisher LSD test. The Tukey HSD test is very conservative, i.e. it has a low

likelihood of declaring differences when none exist, whereas the Fisher LSD test is liberal, i.e. it has a higher likelihood of declaring differences when none exist (Chew 1976). The approach recommended by Dallal (2001) was used to test for the significance of differences between the mean numbers of *C. rosaceana* captured in traps baited with difference blends of synthetic pheromone compounds. The Tukey HSD was first applied and significant differences were accepted. If no differences were found using the Tukey HSD test, the significance of differences between means was then tested using the Fisher LSD test. Dallal (2001) advised that differences judged significant by the Fisher LSD test but not by the Tukey HSD test should be considered open to further investigation. In the present study, the Tukey HSD test identified differences between means only in the experiment where the relative amount of *Z*11-14:Ald was varied in a blend of *Z*11-14:OAc plus 2% *E*11-14:OAc and 1.5% *Z*11-14:OH. This suggests that additional experimentation should be undertaken to confirm the results of the other experiments carried out in this study. The use of a flight tunnel for these studies would eliminate the need to control for possible trap position effects and would permit between-experiment uniformity of sample size. Flight tunnel experiments, however, might not yield pheromone-blend differences that are detectable using a conservative multiple comparison test like the Tukey HSD. For example, Trimble and Marshall (2008) did not detect an increase in the number of *C. rosaceana* males landing at a pheromone source in a flight tunnel when 2% Z11-14:Ald was added to a blend of *Z*11-14:OAc plus 2% *E*11-14:OAc and 1.5% *Z*11-14:OH, whereas in the currently reported field trapping study, a 2.4–3.7-fold increase in the capture of *C. rosaceana* was detected with the addition of 2% of the aldehyde to this blend of compounds.

There is evidence of geographic variation in the optimum ratio of the main pheromone compound and its *E*-isomer. For example, in New York apple orchards, Hill and Roelofs (1979) found that traps baited with the main compound required the addition of at least 3% *E*11-14:OAc to significantly increase the capture of *C. rosaceana*. They also found no difference in the number of moths captured when using relative amounts of *E*11-14:OAc ranging from 3–12%; in their study the number of trapped moths declined when the relative amount of *E*11-14:OAc exceeded 12%. In a Quebec woodlot, Delisle (1992) found that during the first annual flight of *C. rosaceana* traps baited with *Z*11-14:OAc plus 10% *E*11-14:OAc captured more *C. rosaceana* than traps baited with *Z*11-14:OAc plus 3% *E*11-14:OAc; these blends captured similar numbers of moths during the second flight of the year. In Michigan apple orchards, traps baited with the main pheromone compound plus 5% *Z*11-14:OH and 2% *Z*11-14:Ald captured more *C. rosaceana* when *E*11-14:OAc was included at 4% compared to when this compound was included at 1 or 10%, whereas in Oregon apple orchards, the addition of *E*11-14:OAc at 1% resulted in the capture of a greater number of *C. rosaceana* than when this compound was added at 4 or 10% (Stelinski et al. 2007).

There is also evidence of geographic variation in the behavioural activity of *Z*11-14:OH when used as a component of synthetic pheromone for monitoring *C. rosaceana*. For example, in New York apple orchards, Hill and Roelofs (1979) found statistically similar increases of 1.5–2.2-fold in the capture of *C. rosaceana* when 0.5–5% *Z*11-14:OH was added to a two compound blend of *Z*11-14:OAc plus 3% *E*11-14:OAc. In Quebec, Delisle (1992) found that the capture of *C. rosaceana* increased in traps baited with *Z*11-14:OAc plus 2% *E*11-14:OAc when *Z*11-14:OH was added at 1.5% relative to *Z*11-14:OAc, and

as well in traps baited with *Z*11-14:OAc plus 5.6 % *E*11-14:OAc when *Z*11-14:OH was added at 5.6% relative to *Z*11-14:OAc. In Michigan apple orchards, traps baited with the main pheromone compound plus 4% *E*11-14:OAc and 2% *Z*11-14:Ald captured similar numbers of *C. rosaceana* when *Z*11-14:OH was included at 1, 4 and 10% relative to the main compound (Stelinski et al. 2007). In Oregon apple orchards during the first annual flight, the addition of *Z*11-14:OH to the three compound blend used in Michigan at 1% and 4% resulted in similar trap catches of *C. rosaceana*, but trap catch was reduced when the alcohol compound was included at 10% relative to the main compound; trap catch was greatest using 1% *Z*11-14:OH during the second flight period in Oregon (Stelinski et al. 2007).

Geographic variation in the behavioural activity of *Z*11-14:Ald has been previously reported for *C. rosaceana*. The pheromone gland of populations from British Columbia, Michigan, Ontario, Quebec, New York (El-Sayed et al. 2003) and from Oregon (Stelinski et al. 2007) contained *Z*11-14:Ald, and the inclusion of this compound in traps baited with *Z*11-14:OAc, *E*11-14:OAc and *Z*11-14:OH resulted in significant increases in the capture of moths in all of these locations except Michigan (El-Sayed et al. 2003; Stelinski et al. 2007) and New York (El-Sayed et al. 2003). The addition of *Z*11-14:Ald to traps baited with *Z*11-14:OAc, *E*11-14:OAc and *Z*11-14:OH also significantly increased trap catch of *C. rosaceana* in Minnesota apple orchards (Fadamiro 2004). The current study provides additional information on geographic variation in the behavioural activity of *Z*11-14:Ald in *C. rosaceana*. In Niagara apple orchards, there was no change in the number of moths trapped when the relative amount of *Z*11-14:Ald was increased from 1 % to 2%, but trap catch declined when the amount was increase to 4% during the first flight, and to 8% in the second annual flight. In a previous trapping study in Niagara peninsula apple orchards, the capture of *C. rosaceana* declined when the relative amount of *Z*11-14:Ald was increased from 4 to 8% (El-Sayed et al. 2003). By contrast, in British Columbia apple orchards, Vakenti et al. (1988) found no change in the number of *C. rosaceana* captured in traps baited with *Z*11-14:OAc plus 2% *E*11-14:OAc and 1.5% *Z*11-14:OH when *Z*11-14:Ald was added at 2, 4 and 8% relative to *Z*11:14:OAc. Similarly, in Oregon apple orchards, traps baited with the main pheromone compound plus 4% *E*11-14:OAc and 5% *Z*11-14:OH captured similar numbers of *C. rosaceana* when *Z*11-14:Ald was included at 4 and 10% (Stelinski et al. 2007).

In addition to the relative amounts of minor compounds in synthetic pheromone, pheromone dose and formulation can also affect the performance of a synthetic sex-pheromone lure (Wall 1989). In the present study, rubber stoppers were loaded with 1 mg of pheromone but it is not known if this resulted in optimal attractiveness under the conditions in which the effectiveness of different pheromone blends was compared. In British Columbia, Vakenti et al. (1988) found that traps baited with lures loaded with 3 mg of an optimally attractive blend captured 13x more *C. rosaceana* than traps baited with 0.3 mg of the same blend of compounds. The use of the optimally attractive pheromone load in a lure could be important when monitoring small populations of *C. rosaceana*, and therefore additional research should be carried out to determine the relationship between pheromone load and trap catch for this pest in Niagara peninsula apple orchards.

The amount of pheromone loaded into a stopper could also affect its longevity. In the present study the rubber stopper lures were renewed every two weeks during the

4–6 week flight period of *C. rosaceana* in to an attempt to compensate for a change in their attractiveness due to the loss of pheromone, or to a change in the ratio of pheromone compounds. Additional research should also be undertaken to determine the rate of decline in attractiveness of lures to insure that reductions in trap catch are the result of declines in population density and not lure attractiveness.

Sex-pheromone lures can be formulated using rubber, polyethylene or polyvinyl chloride, and the material used to control the release of pheromone will also affect the longevity of a lure (Wall 1989). In addition, the formulation material can also affect the stability of pheromone compounds. For example, McDonough (1991) found that aldehyde pheromone compounds were susceptible to oxidation when formulated on rubber substrates. In British Columbia however, Vakenti et al. (1988) found that the addition of an antioxidant compound to natural rubber lures loaded with *Z*11-14:OAc plus 2% *E*11-14:OAc, 1.5% *Z*11-14:OH and 1% *Z*11-14:Ald had no effect on the number of *C. rosaceana* captured after 10 weeks of field use. This suggests that oxidation of *Z*11-12:Ald should not be a contributing factor to a decline in lure attractiveness when *C. rosaceana* synthetic pheromone is loaded into natural rubber sleeve stoppers.

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REVISION OF *OOCTONUS* (HYMENOPTERA: MYMARIDAE) IN THE NEARCTIC REGION

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The genus *Ooctonus* Haliday (Hymenoptera: Mymaridae) includes 14 species in the Nearctic Region north of Mexico. The known species are redescribed and five new species are described: *O. arizonensis* Huber, **sp. n.**, *O. boltei* Huber, **sp. n.**, *O. longipetiolus* Huber **sp. n.**, *O. readae* Huber, **sp. n.**, and *O. triapitsyni* Huber, **sp. n.** One new synonym is proposed: *O. auripes* Whittaker, **syn. n.**, under *O. vulgatus* Haliday. A key to females is given. Known hosts in North America are Cercopoidea (one species of *Aphrophora* Germar and one of *Philaenus* Stål) and, in the Old World, Cicadellidae (one species of *Nephotettix* Matsumura and one of *Cicadella* Latreille).

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Introduction

Ooctonus Haliday (Hymenoptera: Mymaridae) is predominantly a Northern Hemisphere genus. Twelve species are recorded in the Palaearctic Region and five in the Oriental Region (Triapitsyn 2010). Burks (1979) catalogued eight species in the Nearctic region. Triapitsyn (2010) synonymized two Nearctic names under European names (*americanus* Girault under *vulgatus* Haliday, and *auripes* Whittaker under *notatus* Walker) and recorded three other European species (*hemipterus* Haliday, *insignis* Haliday, and *sublaevis* Foerster) in the Nearctic region, the latter two mistakenly, as discussed below. Three native and one introduced species (*O. vulgatus*) are known from the Southern Hemisphere (Huber et al. 2010).

The Nearctic species are revised here. They are classified into 14 species, 5 of them new. Although no species have been described from south of the USA, a few specimens have been collected from high elevations in Mexico and from Costa Rica, and will be treated separately.

Materials and Methods

About 2040 specimens (about 1050 females and 990 males from Canada and USA) and an additional 210 European specimens identified by Triapitsyn (2010) and 160 specimens identified by the author using the key in Triapitsyn (2010) were seen. The specimens were borrowed from the following institutions (curators in parentheses), or if not borrowed (some types) the depository is given without a curator name.

AEIC – American Entomological Institute, Gainesville, Florida (D. Wahl).
BMNH – Natural History Museum, London, UK (G. Broad).
CAS – California Academy of Sciences, San Francisco, California (R. Zuparko).
CFS-Great Lakes – Canadian Forest Service, Sault Ste. Marie, Ontario (I. Ochoa).
CFS-Pacific – Canadian Forest Service, Victoria, British Columbia (L. Humble).
CLEV – Cleveland Museum of Natural History, Cleveland, Ohio (T. Pucci).
CNC – Canadian National Collection of Insects, Ottawa, Ontario (A. Bennett).
ICCM – Carnegie Museum of Natural History, Insects and Spiders Section, Pittsburg, Pennsylvania (J. Rawlins).
NMID – National Museum of Ireland, Dublin, Ireland.
NMPC – Bouček collection, National Museum (Natural History), Prague, Czech Republic (P. Janšta).
ROM – Royal Ontario Museum, Toronto, Ontario (C. Darling).
UCFC – University of Central Florida, Orlando, Florida (S. Fullerton).
UCRC – University of California, Riverside, California (S. Triapitsyn).
USNM – National Museum of Natural History, Washington, District of Columbia (M. Gates).

Within America north of Mexico some species appear to be fairly uniform throughout their range; others appear to be more variable, making it difficult to describe them and find stable features to distinguish them from other species. A conservative view of species is therefore used to avoid subdividing the genus into numerous 'species' that cannot be defined meaningfully, as was unfortunately done by W. Soyka (1941) for the European *Ooctonus*. Two or more species may be obtained from the same collecting event, so care must be taken to examine all specimens from a locality in case the series is mixed.

Photographs were taken with a digital CCD camera attached to a compound microscope, and the resulting layers combined electronically using Auto-Montage® and retouched as needed with Adobe® Photoshop. Micrographs were taken with a scanning electron microscope after gold coating specimens mounted on stubs with carbon tape or, on occasion, from uncoated specimens on their card or point mounts.

Measurements are given in micrometers (μm). Body length was measured from the transverse trabecula to the gastral apex for critical point dried specimens; the remaining measurements were from cleared and slide mounted specimens. Triapitsyn (2010) should be consulted for most references to species described from Europe and reliably reported in North America, i.e., *O. hemipterus*, *O. notatus*, and *O. vulgatus*. A few references to these species that he missed are given below; the numerous others are not duplicated here.

Structures are labelled mostly on Figs. 6–10 and 193–199, and abbreviations are explained Table 1. Terms are according to Gibson (1997), Krogmann and Vilhelmsen (2006) for the body, Ronquist and Nordlander (1989) and Gibson (2004) for some wing structures. Terms in Viggiani (1970; 1988), and Chiappini and Mazzoni (2000) are used for male genitalia; the basal ring is absent in Mymaridae, so their labeling of it is incorrect.

Two structural characters not previously used in taxonomy of Mymaridae are named here because they are useful to help to define genera or groups of genera within Mymaridae though they may not help distinguish species within a given genus. Both characters are internal and can only be observed in properly cleared and slide mounted specimens. The first character occurs inside the compound eye, seen in lateral view. The eye is rimmed internally by a narrow ocular ridge that becomes more or less widened anteriorly (Takaie 1999, fig. 5B) and often continues well into the eye as a long, slender **ocular apophysis**. In *Ooctonus* species the apophyses are wide and blunt apically (Fig. 62). The second character, named here the **scutellar fenestra**, is a lighter area of varying shape usually between and posterior to the placoid sensilla on the anterior scutellum seen in dorsal view, but in many genera it may occupy much of the anterior scutellum. In *Ooctonus*, the scutellar fenestra (Fig. 140) is a triangle with rounded corners, a narrower apex anteriorly, and wider base posteriorly at the level of the frenal line. Internally, it seems to be defined by a thinning on the underside of the cuticle, hence the lighter colour compared to the surrounding cuticle. The area of thinning partly lines up with the fenestra, a hole through the thin, transverse internal septum across the scutellar-axillar complex present in some genera (Fig. 139, and Krogmann and Vilhelmsen 2006, fig. 10D). A fan-shaped muscle (t_2–t_3) that appears to originate on the posterior ridge of the frenum (its origin is in the metasctellum) fans out anteriorly past the apex of the fenestra. It lies along the inner surface of the frenum for its entire length and can be seen from the outside though the cuticle (Fig. 140) or from the inside (Fig. 139) against the inner surface of the frenum. The shape of the scutellar fenestra differs somewhat among *Ooctonus* species.

Sixty-four *Ooctonus* specimens were submitted for barcoding to the Biodiversity Institute, Guelph, Ontario. Specimens were removed from their cards, DNA was extracted using non-destructive methods (Ivanova et al. 2006; Porco et al. 2010), and returned in ethanol to the CNC where they were critical point dried for a second time and remounted on pins with their tracking numbers and original locality labels, and their identities corrected, where necessary. A 658-bp region near the 5′ terminus of the CO1 gene was amplified using standard primers (LepF1-LepR1). If the internal 658 bp amplification was not successful composite sequences were generated using internal primers. Primer information for individual sequences can be retrieved from the Barcode of Life System (BOLD) (Ratnasingham and Hebert 2007). Collection data for all barcoded specimens are in the Material examined sections. Successful barcodes and the corresponding Genbank sequences are listed in Table 2.

Taxonomy

Ooctonus Haliday, 1833: 269, 343. Type species: *O. insignis* Haliday, designated by Westwood 1839: 78.

Sphecomicrus Haliday in Walker, 1846: 50 (and *errata*). Type species: *O. insignis* Haliday, designated by Peck, 1951: 410.

Ooctonus Haliday: Triapitsyn 2010: 11 (literature, diagnosis, classification, distribution, hosts, keys to Palaearctic, European, and Oriental species); Huber et al., 2010: 222 (African species).

Diagnosis. *Ooctonus* is distinguished from all other genera of Mymaridae by the combination of tarsi 5-segmented, propodeum with diamond-shaped pattern of carinae (Figs. 7, 8, 97–138), fore wing venation about one-third the wing length, and parastigma with hypochaeta next to proximal macrochaeta (Fig. 10). *Boudiennyia* is the most similar genus, differing by the propodeum with an H-shaped pattern of carinae and fore wing venation about half the wing length.

Description. **Female**. **Colour**. Dark brown to black, usually with base of antenna, legs and petiole yellow or brown. **Sculpture**. Head, mesoscutum, mesoscutellum, anterior half of axilla, and sometimes metanotum, propodeum and petiole with fairly conspicuous, usually engraved, reticulate microsculpture, the reticulations largest on the frenum. **Head**. Face without subantennal sulci and without a small pit medially next to each torulus (Figs. 26–39). **Antenna**. Funicle 8-segmented; clava entire (Figs. 63–76), with 8 mps (7 in a few extralimital species) (Fig. 76). **Mesosoma**. Pronotum (Fig. 7) entire, with transverse carina posteriorly separating short, curved collar with strongly angular anterolateral corners from anteriorly tapering neck; notauli complete, deep but thin; propleura broadly abutting anteriorly (Fig. 197), thus separating prosternum from head [prosternum 'closed']; prosternal discrimen complete; prepectus strap-like, about as wide dorsally and ventrally (Figs. 6, 197); frenum more than half length of mesoscutellum and separated from mesoscutellum by curved row of shallow fovea (Fig. 7); metanotum with distinct, usually smooth metascutellum (Fig. 8); propodeum (Fig. 8) with plicae (sublateral carinae of Triapitsyn 2010) extending from posterior margin near outer margin of coxae almost to anterior margin at about level of lateral margins of metascutellum, with submedian carinae arranged in a rhomboid (diamond) shape, and usually with a short transverse carina (costula) extending between submedian carina and plica (the median area of propodeum thus consists of five large, usually complete, pentagonal areoles); anterior margin of propodeum often with a short posteriorly-directed and strongly sclerotized spur almost opposite anterior apex of plica; propodeal nucha short, separated anteriorly from pentagonal areoles by a transverse carina; **Legs**. Tarsi 5-segmented. **Metasoma**. Petiole narrow, much longer than wide (Fig. 195), with posterior half divided by a ventrolongitudinal suture (as in Fig. 198); gaster (Fig. 195) smooth except for slight reticulation around apex of petiole (at junction of gs_1); gt_1 the largest tergum, apparently 3-lobed in dorsal view, the two lateral lobes extending posteriorly and, in lateral view (Fig. 195), with their strongly rounded margins covering anterior sterna and part of gt_2, especially ventrally; gt_1 with a tuft of 3 appressed, posteriorly directed setae next to a deep pit at junction between median and lateral lobes and midway between anterior and posterior margins of tergum; gt_2 almost as long as gt_1; remaining terga short; gt_6 with spiracle; gt_7 with cerci, in dorsal view, separated from each other by more than a cercus width.

Male. Similar to female except antenna, sometimes ocelli and shape of gaster (Fig. 196). Flagellum 11-segmented, each with several mps extending almost entire length of segment. Ocelli usually slightly larger than in female, e.g., Figs. 46 vs 47 and Figs. 54 vs 55. Metasoma without spiracle. Gaster with gs_1 the longest segment (Fig. 199), but it and following sterna often hidden by terga (Fig. 198). Genitalia (Figs. 178–186, 191–194) usually at least half length of gaster, with a long, tubular phallobase, aedeagal apodemes apparently not articulated but continuous with base of aedeagus, digiti with 3 teeth and 'parameres' slender and fairly long.

Males usually have darker legs than females. This is most noticeable in species with uniformly yellow legs in females. In one species, *O. hemipterus*, male fore wing shape is different from wing shape in macropterous females (micropterous males are not known).

Species characters. The species within almost any genus of Mymaridae are often very similar, difficult to characterize and distinguish from one another. Usually, several qualitative features and quantitative features (measurements, ratios, numbers of sensilla, structural features) taken together are needed to distinguish a species. In *Ooctonus*, the most important feature for all species is the pattern of propodeal carinae, and mps distribution on and proportions of female flagellar segments. Other qualitative characters that help define some species are: leg, antenna, and petiole colour, relative size of compound eye, ocellar diameter relative to LOL, presence of a stemmaticum (Fig. 43—white lines in cleared specimens from mid to lateral ocelli), mesosomal seta length, and wing shape. Microsculpture, of the mesonotal midlobe in particular, varies subtly among species and, if present (occasionally it is absent medially on frenum) is best described using two features: the mesh surrounding each cell, its shape and whether it is above or below the cell, and the cell itself (sculpticell, Goulet 1996: 23) (whether it is higher or lower relative to the mesh). It is best seen in scanning electon micrographs (Figs. 100–102, 106–108, 112–114, 118–120 123–138). Other characters that are sometimes useful are fore and hind wing proportions, presence or absence of a hair line/wing fold, fore wing marginal vein length, female gaster shape, and ovipositor/metatibia ratio.

Males are difficult or impossible to identify to species (as is usual for Mymaridae) unless they can be clearly associated with the corresponding females. Male antennae vary in length, with length/width of fl_6 varying from 2.85–5.03 and total flagellum length varying from 918–2027, depending on the specimen and the species. Because male antennal length and flagellomere proportions can vary considerably within a species and there is often substantial overlap in these measurements they are often not useful for species identification. Flagellomere shape may sometimes be useful, varying from evenly cylindrical to slightly swollen basally. Overall length of the genitalia, shape and length/width proportions of the phallobase, and length of aedeagal apodemes compared to the aedeagus vary among the species.

Type material. Whittaker (1931) described four species of *Ooctonus*. In his brief introduction he stated that a paratype of each species was placed in the USNM but gave no other depositories for the remaining specimens. They were found in the BMNH. He also did not specifically state under each species description that one specimen was the holotype. A red label with "paratype" typed on it is pinned under each specimen in the USNM and a

second red paratype label with a USNM number was later added. A red label with "type" written in black ink on it is pinned under one specimen of each of the Whittaker species in BMNH and a lectotype label (white circle with purple border) is the top label on one specimen of each of them but this was clearly added later and the lectotype designation was not published. Despite the red 'type' or 'paratype' labels on the specimens, I formally designate below the specimens bearing lectotype labels in the BMNH as lectotypes because no holotypes were specified in the original descriptions.

Biology. The few host records available indicate that *Ooctonus* species parasitize eggs of Cercopoidea and, less often, Cicadellidae. Members of both host families cause direct feeding damage and may also transmit plant pathogens (Hamilton 1982; Nault 1989; Dupo and Barrion 2009). Triapitsyn (2010) summarized the few host records for the Palaearctic region—*O. orientalis* Doutt parasitizes *Nephotettix cincticeps* (Uhler) (cited in Doutt 1961) and *Cicadella viridis* L. (Doutt 1961) (Cicadellidae). An unidentified species, questionably of *Ooctonus*, parasitizes *Nephotettix virescens* (Distant) on rice (Dupo and Barrion 2009). The only previously published hosts for *Ooctonus* in North America are *O. aphrophorae* Milliron on *Aphrophora saratogensis* (Fitch) (Milliron 1947) and *O. vulgatus* (as *O. americanus*) on *Philaenus spumarius* (L.) (Weaver and King 1954). The white pine weevil, *Pissodes strobi* Peck (Curculionidae), is recorded below as a host of *O. quadricarinatus*. This record is doubtful and needs confirmation before it can be accepted as reliable.

Key to Nearctic *Ooctonus* species in America North of Mexico. Females.

1 Micropterous or brachypterous, the wings not extending beyond apex of gaster (Fig. 1) and venation length at least half wing length (Figs. 147, 148)..... .....*hemipterus* Haliday (part)

– Macropterous, the wings extending well beyond gastral apex (Figs. 2–5) and venation length much less than half wing length (Figs. 141–146, 149–158)...2

2(1) Ovipositor at least 1.7× as long as metatibia and exserted considerably beyond apex of gaster (Figs. 3, 159, 187, 189); legs black or dark brown, coxae almost same colour as mesosoma (Fig. 3).....3

– Ovipositor at most 1.4× as long as metatibia and at most only slightly exserted beyond apex of gaster (e.g., Figs. 2, 160); legs yellow or brown, coxae usually different in colour from mesosoma, yellow or light brown (Figs. 1, 2, 4, 5) but sometimes (*O. fuscipes*) dark brown.....4

3(2) Gaster unusual in shape (Figs. 159, 187), in lateral view with dorsal margin of gt_1 concave posteriorly and gaster projecting anteriorly under mesosoma; petiole attached about 0.25× gaster length from anterior apex of gaster; funicle without mps on fl_5 or fl_6 (Fig. 63).....*aphrophorae* Milliron

– Gaster normal in shape (Figs. 160–177, 188–190), in lateral view with dorsal margin of gt_1 more or less straight; petiole attached almost at anterior apex of gaster; funicle with 1 (rarely 0) mps on fl_5 and 1 on fl_6 (Fig. 72)..... .....*quadricarinatus* Girault

4(2) Vertex with stemmaticum [on cleared specimens seen as white lines extending from supraorbital trabecula along eye margin to mid ocellus and from mid ocellus to lateral ocelli (Figs. 41, 43, 45); on dry specimens seen as lines or slightly raised ridges (Figs. 52, 53, 56)].....5

– Vertex without stemmaticum (Figs. 40, 42, 44, 54, 55, 57–61).....8

5(4) Mesosoma laterally and propodeum between major carinae entirely covered with reticulate sculpture (Figs. 105, 108, 130); fore wing apex rounded and with distinct brown basal band (Fig. 146).....*hemipterus* Haliday (part)

– Mesosoma laterally and propodeum between major carinae entirely smooth (Figs. 90, 91, 93, 94, 96, 126–129, 131–138); fore wing apex truncate and without brown band (Figs. 141–145, 150–158).....6

6(5) Propodeal spur absent (Figs. 111, 114, 133) [also absent in *hemipterus*, Figs. 92, 105, 108, 130]; mesoscutum without median longitudinal groove (Fig. 111); fl_4 without mps (Fig. 71).....*occidentalis*

– Propodeal spur present (Figs. 125–129, 131, 132, 134–136); mesoscutum with median longitudinal groove (Figs. 103, 106, 109, 112); fl_4 with at least 1 mps (Figs. 66, 69).....7

7(6) Petiole shorter than combined lengths of metacoxa and metatrochanter (Fig. 162); clava short, at most 0.18× funicle length; entire funicle longer, e.g., length/width ratio of fl_2 at least about 5.8 (Fig. 66).....*canadensis* Whittaker

– Petiole longer than combined lengths of metacoxa and metatrochanter (Fig. 165); clava longer, at least 0.26× funicle length; entire funicle shorter, e.g., length/width ratio of fl_2 at most about 3.8 (Fig. 69).....*longipetiolus* Huber, **sp. n.**

8(4) Frenum smooth medially (Figs. 116, 117, 119, 120, 122, 124), rarely reticulate only in posterior third.....9

– Frenum entirely reticulate (Figs. 97–115, 118, 121, 123), sometimes only faintly so.....11

9(8) Fl_5 and fl_6 without mps (Figs. 74, 76).....10

– Fl_5 with 1 mps and fl_6 with 1 (rarely without) mps (Fig. 73).....*readae* Huber, **sp. n.**

10(9) Propodeum without a median carina, the pentagonal areole joined to anterior margin of propodeum by converging dorsolateral carinae (Figs. 122, 124, 138); marginal + stigmal vein short (Fig. 158); funicle with fl_1–fl_4 relatively long, e.g., fl_2 length/width at least about 2.7 (Fig. 76); ocelli small (16 µm), LOL about 4.0× mid ocellar diameter (Fig. 61).....*vulgatus* Haliday

– Propodeum with a short median carina, the pentagonal areole thus separated from anterior margin of propodeum (Figs. 117, 120, 136); marginal + stigmal

vein longer (Fig. 156); funicle with fl_1 – fl_4 relatively short, e.g., fl_2 length/width at most 2.3 (Fig. 74); ocelli larger (24 µm), LOL about 2.0× mid ocellar diameter (Fig. 59).....*silvensis* Girault

11(8) Fl_5 without mps (Fig. 67), rarely with 1 mps on one antenna.....*fuscipes* Whittaker

– Fl_5 with 1 or 2 mps on both antennae.....12

12(11) Propodeum without a median carina, the pentagonal areole joined to anterior margin by converging dorsolateral carinae (Figs. 110, 113, 132); fl_6 without mps (Fig. 70); smaller species, with body at most 930 µm long and fore wing length at most 950 µm long.....*notatus* Walker

– Propodeum with a median carina, the pentagonal areole distinctly separated from anterior margin; fl_6 with at least 1 mps, rarely without; larger species, with body at least 1075 µm long and fore wing length at least 1100 µm long.....13

13(12) Ovipositor shorter, at most 0.80× metatibia length.....*boltei* Huber, **sp. n.**

– Ovipositor longer, at least 0.97× metatibia length.....14

14(13) Legs uniformly yellow; apical funicle segments shorter and wider, e.g., fl_4, fl_5, fl_6 length/width ratios at most 2.19, 2.07, and 1.81, respectively; body slightly shorter, at most 1330 µm.....*triapitsyni* Huber, **sp. n.**

– Legs mainly brown; apical funicle segments longer and narrower, e.g., fl_4, fl_5, fl_6 length/width ratios at least 2.40, 2.33, 1.99, respectively; body slightly longer, at least 1350 µm.....*arizonensis* Huber, **sp. n.**

Ooctonus aphrophorae Milliron

(Figs. 26, 46, 47, 63, 77, 89, 97, 100, 125, 141, 159, 178, 187, 191)

Ooctonus aphrophorae Milliron, 1947: 219; Peck, 1951: 410 (catalogue); Ewan, 1961: 43 (host); Peck, 1963: 18 (catalogue); Herting, 1972: 10 (host); Wilson, 1978: 3 (percent parasitism); Burks, 1979: 1027 (catalogue, Ohio record).

Type material. Holotype ♀ in USNM (examined), on triangular card point labelled 1. "USA: Wisc. Lakewood, 18 Sept. '46". 2. "Ex egg of *Aphrophora saratogensis* (Fitch)". 3. "Ooctonus ♀ aphrophorae Milliron '46 Holotype". 3. "Type No. 58267 U.S.N.M.".

Paratypes. 75♀, 42♂ (USNM, examined). **USA. Wisconsin**. *Oconto Co.*: Lakewood, 18, 20, 21 and 26 ix.1946, ex *Aphrophora saratogensis*. The paratype numbers are lower than reported by Milliron (1947) because several card triangles examined no longer had specimens on them.

Diagnosis. *Ooctonus aphrophorae* is distinguished from other Nearctic species by the unusual gaster that projects anteriorly under the mesosoma and is very narrow anteriorly (Fig. 159), with the petiole attached quite far from the anterior apex of the gaster and the dorsal surface of gt_1 concave posteriorly (Fig. 187).

In colour *O. aphrophorae* is most similar to *O. quadricarinatus* (both have black coxae) but the body is smaller, antennal segments are shorter and without mps on fl_5 and fl_6 (Fig. 63) (*O. quadricarinatus* with mps on fl_5 and fl_6), and the metascutellum and anterolateral areole have some reticulate sculpture (Fig. 125) (*O. quadricarinatus* without sculpture).

Description. **Female**. Body length 1152–1357 (critical point dried, Constance Bay, Ontario, n=5) or 1126–1280 (air dried, Lakewood, Wisconsin, n=5), all in natural position. Head and mesosoma black, metasoma dark brown; antenna brown except sometimes radicle and pedicel laterally, and sometimes flagellum light brown; legs brown, except base and apex of tibiae, and tarsomeres 1–4 yellowish. **Head**. Head (Fig. 26) width (n=4) 323–334. Vertex without stemmaticum (Fig. 46). Mid ocellus diameter 26–29. **Antenna**. Flagellum (Fig. 63) with 2 mps on fl_7, 2 on fl_8, and 7 on clava. Fl_1 usually slightly the longest funicle segment. Fl_1–fl_6 length/width ratios (n=5): fl_1 2.86–3.23, fl_2 2.33–3.02, fl_3 2.35–3.31, fl_4 2.29–3.03, fl_5 2.06–2.78, fl_6 1.69–2.29; clava 3.62–4.10× as long as wide, and almost as long as fl_5–fl_8 together. Measurements (length/width, n=5): scape 199–231/39–44, pedicel 68–71/33–36, fl_1 56–69/19–21, fl_2 50–60/20–23, fl_3 55–72/22–24, fl_4 51–66/21–24, fl_5 54–67/24–27, fl_6 47–59/25–28, fl_7 59–67/31–34, fl_8 58–64/34–37, clava 178–216/48–54. Total flagellum length 608–749. **Mesosoma**. Pronotum (Figs. 97, 100) with collar wide, moderately long and clearly visible in dorsal view, with well defined carina. Mesonotum (Fig. 97, 100-male) wide; midlobe of mesoscutum with meshes engraved; scutellar seta long, extending posterior to straight or medially slightly concave frenal line; frenum about 0.75× mesoscutellum length and entirely reticulate, with a few short carinae extending posteriorly from anterior margin. Metanotum with metascutellum long, with several irregular and incomplete carinae extending towards each other from anterior and posterior margins, and lateral lobes smooth except for about 2 longitudinal carinae (Fig. 89-male). Propodeum (Figs. 97, 100-male, 125) smooth between carinae, except anterolateral areole with some reticulate sculpture, and anterior margin of propodeum with a stub slightly lateral to lateral margin of metascutellum; median areole separated from metascutellum by at most a very short median carina (appearing double in slide mounts); plica almost straight, its anterior apex in line with apex of stub, with medial branch of anterior bifurcation extending almost to anterior margin of propodeum and lateral branch short and curved. **Wings**. Fore wing (Fig. 141) length 1207–1323, width 463–534, length/width 2.48–2.70, longest marginal setae 56–92, about 0.15× as long as greatest wing width (n=6). Hind wing (Fig.141) length (n=5) 969–1046, width 60–75, longest marginal setae 90–115. **Metasoma**. Petiole shorter than metacoxa + macrotrochanter. Gaster (Fig. 159) with ovipositor length 977–1237 (n=6), 1.99–2.44× as long as metatibia length (480–528) and distinctly projecting beyond gastral apex (Figs. 159, 187).

Male. Body length. 1178–1306 (n=10). Antenna (Fig. 77). Measurements, length (n=2): scape 158–164, pedicel 56–66, fl_1 116–129, fl_2 135–137, fl_3 129–131, fl_4 129–130, fl_5 127–131, fl_6 129–130, fl_7 127–130, fl_8 125–129, fl_9 125–127, fl_{10} 119–125, fl_{11} 124–138. Propodeum (Fig. 100) as in female. Total flagellar length 1386–1436. Fl_6 length/width 3.38–3.52, with about 9 mps. Mid ocellus (Fig. 47) diameter 29–36. Gaster (Fig. 191). Genitalia fairly wide (dorsal view) for most of length (Figs. 178, 191).

Hosts and Habitat. The host is *Aphrophora saratogensis* (Fitch). Specimens were obtained by rearing host eggs and sweeping Jack pine; one male emerged from old host eggs in dead red maple twigs (Milliron 1947). The species is solitary—only one wasp emerges from a host egg. The rearing record from *Rhyacionia* (as *Evetria*) *buoliana* [(Denis and Schiffermüller)] (Tortricidae) is almost certainly incorrect, as are any of the very few records of Mymaridae from Lepidoptera. However, it possibly represents an opportunistic and evidently successful parasitism of an unusual host egg in the same microhabitat (pine shoots) in which the normal host would be found.

Material examined. 44♀ and 32♂ in addition to type material. **CANADA. Ontario**. Constance Bay [near Ottawa], 12-19.x.1973, G. Gibson, YPT (1♀, CNC), 21.viii-7.ix.1983, M. Sanborne (2♀, 1♂, CNC). **Quebec**. Luskville falls [near Gatineau], 300m, 17-22.ix.1986, J. Denis, L. Dumouchel, YPT (1♀, CNC). **USA. New York**. *Nassau Co.*: Nassau Boulevard, 18.ix.1915, L.C. Griffith, ex *Evetria buoliana* (1♀, 1♂, USNM). **Wisconsin**. *Oconto Co.*: Lakewood, 5, 9, 13, 17, 18, 20, 22, and 23.ix.1946 ex *A. saratogensis* eggs (19♀, 14♂, USNM), 11, 12, 13, 14, 15, 18, 19, 20, and 21.ix.1946, sweeping Jack pine (19♀, 15♂, USNM), ex egg of *A. saratogensis* coll. 5.ix and emerged 7.ix.1946 (1♂, USNM), ex eggs of *A. saratogensis* coll. 18.ix and emerged 25.ix.1946 (3 empty eggs, 1♀ still stuck to an egg, USNM).

Ooctonus arizonensis Huber, sp. n.

(Figs. 19, 27, 40, 48, 64, 78, 90, 98, 101, 126, 142, 160)

Type material. Holotype ♀ in CNC, on slide (Fig. 19) labelled 1. "USA: AZ, Cochise Co. Chiricahua Mts. Rustler Park, 6000′, 15.vii.1982, G. Gibson". 2. "Ooctonus arizonensis Huber Holotype ♀ dorsal".

Paratypes. 12♀ and 49♂. **USA**. **Arizona**. *Cochise Co.*: same data as holotype (1♂, CNC); Chiricahua Mountains, Barfoot Park, ca. 8600′, 26.viii.1982, J. LaSalle (1♂, CNC), Rustler Park, 8200′, 26.viii.1982, J. LaSalle, sweeping (2♀, 1♂, CNC), 8300′, 23.viii, 21.ix.1987, H. & M. Townes (1♀, 3♂, AEIC); Carr Canyon, summit camp, 8000′, 18.viii.1993, M. Sharkey (1♀, 1♂, CNC); Huachuca Mountains, Miller Canyon, 1600m, 11.viii.1982, G. Gibson (2♀, CNC); Portal, 5000′, 19.x.1978, L. Masner, C. Yoshimoto (1♀, CNC); Portal, 2, 4, 6, 18, 21.ix.1987, H.K. Townes (1♀, 11♂, AEIC); Portal, Southern Research Station, 11.ix.1978, G. Gordh (1♀, UCRC); 12 mi. S. Sierra Vista, Ramsey Canyon, 1700m, 17.v, 6-13.vii CNCHYM07510 [barcode failed], 24.vii, 4-22.ix CNCHYM07511, 27.ix, 11.x, 26.xi-5.xii.1986, B.V. Brown, oak/juniper, MT (1♀, 29♂, AEIC, CNC). *Pima Co.*: Santa Catalina Mountains, Molino Basin, 4200 and 4300′, 2-4.viii.1982, G. Gibson (2♀, 2♂, CNC).

Derivation of specific epithet. The species is named after the state in which all the specimens were collected.

Diagnosis. *Ooctonus arizonensis* is distinguished from other Nearctic species by the combination of body length greater than about 1350 µm, brown legs, and usually 1 mps on fl_5 and fl_6 (Fig. 64) and ovipositor at most scarcely exserted.

Ooctonus arizonensis is similar *O. quadricarinatus* in size but the latter has a distinctly exserted ovipositor. *O. arizonensis* is most similar to *O. fuscipes* but the latter lacks mps on fl_5 and fl_6. Barcoding suggest that the latter two are closely related. Because of differences in number of mps on fl_5 and fl_6 and different ranges (Arizona mountains vs Pacific coast forests) I treat them as separate species.

Description. **Female**. Body length 1357–1510 (n=5). Head and mesosoma very dark brown, metasoma brown; scape and pedicel yellowish to light brown laterally, remainder of flagellum dark brown; petiole and legs, light brown. **Head**. Head (Fig. 27) width (n=4) 347–372. Vertex without stemmaticum (Fig. 40, 48-male). Mid ocellus diameter 25–31. **Antenna**. Flagellum (Fig. 64) with 1 (exceptionally 2) mps on fl_5, 1 or 0 mps on fl_6, 2 mps on fl_7 and fl_8, and 7 mps on clava. Fl_5 slightly the longest funicle segment. Fl_1–fl_6 length/width ratios: fl_1 2.95–3.39, fl_2 2.57–3.02, fl_3 2.56–2.83, fl_4 2.40–2.67, fl_5 2.33–2.47, and fl_6 1.99–2.23; clava 3.07–3.91× as long as wide, and slightly longer than fl_6–fl_8 together. Measurements, length/width (n=5): scape 239–255/38–45, pedicel 69–75/37–39, fl_1 62–69/20–23, fl_2 63–70/22–24, fl_3 63–71/24–26, fl_4 57–63/23–25, fl_5 64–72/27–30, fl_6 53–62/26–29, fl_7 65–75/29–35, fl_8 63–68/32–40, clava 205–230/56–67. Total flagellum length 695–780. **Mesosoma**. Pronotum (Figs. 98, 101) with collar wide, moderately long and clearly visible in dorsal view, with well defined carina. Mesonotum (Figs. 98, 101) wide; midlobe of mesoscutum with meshes engraved; scutellar seta short, extending to medially slightly curved frenal line; frenum 0.62–72× mesoscutellum length and entirely reticulate. Metanotum with metascutellum smooth. Propodeum (Fig. 126) smooth between carinae and its anterior margin with stub, the latter just lateral to lateral margin of metascutellum; median areole separated from metascutellum by median carina; plica curved, extending almost to anterior margin of propodeum just medial to stub, without an anterior bifurcation but with a slight curved thickening posterior to the stub. **Wings**. Fore wing (Fig. 142) length 1457–1568, width 513–553, length/width 2.83–2.95, longest marginal setae 84–99, about 0.17× as long as greatest wing width (n=5). Marginal vein length about 173. Hind wing (Fig. 142) length 1138–1264, width 61–76, longest marginal setae 128–141. **Metasoma**. Petiole shorter than metacoxa + mesotrochanter. Gaster (Fig. 160) with ovipositor length 546–569 (n=5), 0.97–1.18× as long as metatibia (507–561).

Male. Body length 1331–1587 (n=10). Legs darker than in female. Antenna (Fig. 78). Measurements, length (n=5): scape 185–220, pedicel 64–73, fl_1 105–134, fl_2 115–141, fl_3 110–135, fl_4 107–135, fl_5 110–114, fl_6 106–132, fl_7 105–134, fl_8 102–128, fl_9 105–127, fl_{10} 95–121, fl_{11} 94–126. Total flagellar length 1163–1446. Fl_6 length/width 3.11–3.89, with 7 or 8 mps. Eye small (Fig. 90). Mid ocellus (Fig. 48) diameter 28–30.

Barcoding. Five specimens were submitted for barcoding, all of them males, and one (CNCHYM07511) yielded a barcode. Because males are usually unidentifiable it is difficult to be sure what species they represented prior to barcoding but the only two possibilities based on locality data are *O. arizonensis* (CNCHYM07511) and *O. triapitsyni*. Based on their larger size, two of the specimens (CNCHYM07510 and CNCHYM07511) are *O. arizonensis* and have the same data as some females of that species. The remaining three specimens are listed under *O. triapitsyni*. CNCHYM07511 is almost identical to that of *O. fuscipes* specimens (1 base pair difference), suggesting that *O. arizonensis* and *O.*

fuscipes are the same species. They are kept separate because of slight differences in the proportions of fl_5 and fl_6, different distribution of mps (mps present on fl_5 and usually fl_6 in *arizonensis*, absent in *fuscipes*), and different geographic ranges.

Hosts and habitat. Hosts are unknown. Specimens have been collected in an oak/juniper habitat.

Ooctonus boltei Huber, sp. n.

(Figs. 20, 28, 49, 65, 99, 102, 127, 143, 161)

Type material. Holotype ♀ in CNC, on slide (Fig. 20) labelled 1. "Canada: MB, Riding Mt. Nat. Park, 3 km E. Clear Lake, 29.VIII.1979 S.J. Miller, pitfall trap, beaver meadow". 2. "Ooctonus boltei Huber ♀ dorsal".

Paratypes. 8♀ and 3♂. **CANADA**. **Manitoba**. Same data as holotype, CNCHYM07481 [barcode failed] (2♀, CNC); Aweme, Criddle Homestead, 49°42′34″N 99°34′58″W, 24.vii.2007, H. Goulet, mixed grass prairie, CNCHYM07479 [barcode failed] (1♂, CNC); Riding Mountain National Park, 1 km E. Clear Lake, 16.viii.1979, S.J. Miller, small meadow, Malaise trap (1♀, CNC), near refuse pit, 29.vii.1979, S.J. Miller, aspen stand, pan trap, CNCHYM07483 [barcode failed] (1♀, 1♂, CNC), Wishing Well road, 20.viii.1979, D.B. Lyons, CNCHYM07482 [barcode failed) (2♀, 1♂, CNC); 0.1 km N. Onanole, 29.viii.1979, S.J. Miller, field-forest edge (1♀, CNC). **New Brunswick**. Fundy National Park, Wolfe Point campground, 27.viii.1984, M. Kaulbars (1♀, CNC).

Derivation of specific epithet. The species is named after Klaus Bolte, an outstanding technician at the CNC for almost four decades, who worked for the author from 1988 until his retirement.

Diagnosis. *Ooctonus boltei* is distinguished from other Nearctic species by the combination of fl_6 without mps (exceptionally one antenna with 1 mps), uniform yellow legs, entirely reticulate mesoscutellum, ovipositor at most 0.78× as long as metatibia, and body length at least 1300μm.

Ooctonus boltei is similar to *O. triapitsyni*, which also has uniform yellow legs, but differs by the absence of mps on fl_5 (mps present in *O. triapitsyni*) and ovipositor shorter than metatibia (longer than metatibia in *O. triapitsyni*). It is also similar to *O. notatus* but has the ovipositor shorter than metatibia (longer in *O. notatus*).

Description. **Female**. Body length 1331–1434 (n=5). Head and mesosoma dark brown, metasoma brown; fl_1–fl_3 light brown to brown, remainder of flagellum dark brown; petiole, legs, scape and pedicel uniformly yellow, though sometimes scape and pedicel light brown and fl_1–fl_3 honey yellow. **Head**. Head (Fig. 28) width (n=3) 375–390. Vertex without stemmaticum. Mid ocellus diameter 26 (Fig. 49). **Antenna**. Flagellum (Fig. 65) with 1 (exceptionally 2) mps on fl_5, 1 or 0 mps on fl_6, 2 mps on fl_7 and fl_8, and 7 mps on clava. Fl_1 slightly the longest funicle segment. Fl_1–fl_6 length/width ratios: fl_1 3.61–3.98, fl_2 2.85–3.55, fl_3 2.69–3.09, fl_4 2.43–2.88, fl_5 2.44–2.97, fl_6 2.27–2.55; clava 3.96–4.38× as long as wide and shorter than fl_5–fl_8 together. Measurements (length/width, n=3): scape 240–270/41–42, pedicel 68–73/34–39, fl_1 76–83/21, fl_2 65–83/22–23, fl_3 69–79/26, fl_4 59–70/24–26, fl_5 66–

74/25–27, fl_6 59–66/24–27, fl_7 72–78/30–36, fl_8 68–75/32–39, clava 238–249/54–63. Total flagellum length 772–857. **Mesosoma**. Pronotum (Figs. 99, 102) with collar moderately wide, long and clearly visible in dorsal view, with well defined carina. Mesonotum (Figs. 99, 102) wide; midlobe of mesoscutum with meshes raised; scutellar seta fairly short, extending to almost straight frenal line; frenum 0.64–0.69× mesoscutellum length and entirely reticulate. Metanotum with metascutellum smooth. Propodeum (Fig. 127) smooth between carinae and its anterior margin with a stub just lateral to lateral margin of metascutellum; median areole separated from metascutellum by short median carina; plica almost straight, extending almost to anterior margin, not bifurcate anteriorly. **Wings**. Fore wing (Fig. 143-male) length 1433–1515, width 494–505, length/width 2.90–3.00, longest marginal setae 66–72, about 0.14× as long as greatest wing width (n=3). Marginal vein length 168–180. Hind wing (Fig. 143-male) length 1102–1160, width 58–59, longest marginal setae 104–135. **Metasoma**. Petiole shorter than metacoxa + mesotrochanter. Gaster (Fig. 161) with ovipositor length 431–476 (n=3), 0.74–0.78× as long as metatibia (560–611).

Male. Body length 1357 (n=1). Colour as in female except pedicel dorsally and entire flagellum brown. Antennal measurements, length (n=1) scape 213, pedicel 71, fl_1 126, fl_2 137, fl_3 129, fl_4 134, fl_5 131, fl_6 128, fl_7 131, fl_8 126, fl_9 125, fl_{10} 113, fl_{11} ca 107. Total flagellar length 1387. Fl_6 length/width 3.64, with about 6 mps. Mid ocellus diameter 30.

Hosts and habitat. Hosts are unknown. Specimens have been collected in a small meadow, aspen stand, and field/forest edge.

Barcoding. Four specimens (CNCHYM07479, CNCHYM07481, CNCHYM07482, and CNCHYM07483) were submitted but no barcodes were obtained.

Ooctonus canadensis Whittaker

(Figs. 12, 29, 41, 50, 66, 79, 103, 106, 128, 144, 162, 183)

Ooctonus canadensis Whittaker, 1931: 190; Peck, 1951: 410 (catalogue); Peck, 1963: 18 (catalogue); Burks, 1979: 1027 (catalogue).

Ooctonus sublaevis Foerster: Triapitsyn, 2010: 47 (misidentification). The male specimen from Alaska, listed below, bears a 2009 identification label by Triapitsyn reading "*Ooctonus* sp. *insignis*-type" but was incorrectly published as *O. sublaevis*.

Type material. Lectotype ♀ in BMNH (examined), here designated to avoid ambiguity about the status of the type specimens of this species, on card (Fig. 12) labelled 1."Lectotype [purple edged circle]". 2. "Type [red rectangular label]". 3. "Holyburn, B.C. 7.IX.30 Coll. O.W.". 4. Canada: O. Whittaker Coll. per W.H. Storey. B.M. 1947 - 212.". 5. Ooctonus canadensis Whitt. ♀ Det. O. Whittaker". 6. "B.M. Type Hym. 5.2320". The lectotype is mounted dorsal side up on a card with wings, legs, and antennae (dorsal view) spread out.

Paralectotype. One ♀ in USNM (examined), mounted in same way as lectotype and labelled 1. "Paratype". 2. "Paratype No. 43551 U.S.N.M." 3. "Hollyburn, B.C. 31.VIII.30 Coll. O.W.". 4. "Ooctonus canadensis Whitt. ♀ Det. O. Whittaker".

Diagnosis. *Ooctonus canadensis* females are distinguished from other Nearctic species by

the combination of vertex with stemmaticum (Figs. 41, 50), relatively short clava (Fig. 66), midlobe of mesoscutum with long median groove, and propodeum with plicae straight but diverging and bifurcating anteriorly, with the medial arm long, curved and almost touching anterior margin of propodeum and the lateral arm almost straight and extending as far as level of spiracle (Figs. 103, 106, 128).

Ooctonus canadensis is most similar to *O. longipetiolus*, **sp. n.**, which has most of the above features but in *O. canadensis* the plica diverge more (less in *O. longipetiolus*), the petiole is not much longer than the metacoxa (distinctly longer in *O. longipetiolus*), and the ovipositor is as long as the metatibia (0.7× as long in *O. longipetiolus*).

Description. **Female**. Body length 1382–1664 (n=5). Head and mesosoma dark brown, metasoma and flagellum brown; scape, pedicel, and legs except metacoxa dark yellow, metacoxa brownish yellow. **Head**. Head (Fig. 29) width 351–356 (n=2). Vertex (Fig. 41-male, 50-male) with stemmaticum. Mid ocellus diameter about 45. **Antenna**. Flagellum (Fig. 66) with 2 mps on fl_4–fl_8 (one specimen with only 1 mps on fl_4 of one antenna) and 7 mps on clava. Fl_2 the longest funicle segment. Fl_1–fl_6 length/width ratios: fl_1 4.86–5.60, fl_2 5.77–6.92, fl_3 5.04–5.98, fl_4 4.07–4.82, fl_5 2.76–3.27, fl_6 2.76–3.42; clava 3.17–4.23× as long as wide, slightly longer than fl_7 and fl_8 together. Measurements (length/width, n=2): scape 241–254/42–50, pedicel 71/39–41, fl_1 113–130/22–23, fl_2 130–143/23, fl_3 129–139/26–27, fl_4 116–122/29–32, fl_5 103–109/32–35, fl_6 87–98/28–34, fl_7 81–93/30–31, fl_8 71–78/31–32, clava 167–184/44–53. Total flagellum length 997–1096. **Mesosoma**. Pronotum (Figs. 103, 106-male) with collar narrow, long and clearly visible in dorsal view, with well defined carina. Mesonotum (Figs. 103, 106-male) moderately wide; midlobe of mesoscutum with meshes engraved and with longitudinal median groove; scutellar seta long, extending posterior to medially concave frenal line; frenum about 0.6× mesoscutellum length and entirely reticulate. Metanotum with metascutellum smooth. Propodeum (Fig. 128-male) smooth between carinae and its anterior margin with stub slightly lateral to lateral margin of metascutellum; dorsolateral areole with a thin, wavy or broken carina close to and parallel with anterior margin; median areole well separated from metascutellum by long median carina not extending to metascutellum; dorsolateral areole much larger than ventrolateral areole; plica straight, not extending to metascutellum (if it did, it would meet metascutellum lateral to its lateral margin) and bifurcate anteriorly with a long lateral and shorter medial arm. **Wings**. Fore wing (Fig. 144) length 1676–1800, width 598–640, length/width 2.80–2.81, longest marginal setae 92–104, about 0.33× as long as greatest wing width. Hind wing (Fig. 144) length 1293–1344, width 60–65, longest marginal setae 130 (n=2). **Metasoma**. Petiole shorter than metacoxa + metatrochanter. Gaster (Fig. 162) with ovipositor length (n=2) 555–617, 0.96–1.08x as long as metatibia (579–590).

Male. Body length. 1485–1587 (n=4). Antenna (Fig. 79). Measurements, length (n=1): scape 195, pedicel 62, fl_1 163, fl_2 192, fl_3 192, fl_4 194, fl_5 197, fl_6 193, fl_7 188, fl_8 180, fl_9 173, fl_{10} 148, fl_{11} 148 (last two flagellomeres measured from critical point dried specimen). Total flagellar length 1820. Each flagellomere bottle-shaped, distinctly wider towards base. Fl_6 length/width 4.56, with about 7 mps. Mid ocellus diameter 41 (Figs. 41, 50). Genitalia fairly narrow for anterior half of length (Fig. 183, 193).

Hosts and habitat. Hosts are unknown. Specimens have been collected during two of the same collecting events as *O. occidentalis* but *O. canadensis* is evidently much less common. Specimens of both species from California were swept from under story vegetation (ferns) in a redwood forest (L. Masner, personal communication) and both species were collected at Dredge Lake, Alaska.

Barcoding. One of two specimens yielded a DNA barcode (CNCHYM07506) but the other did not (CNCHYM07505) so nothing can be said about intraspecific variation based on DNA. I had incorrectly assigned CNCHYM07506 to *O. occidentalis* prior to barcoding. The relatively large difference in barcodes (ca. 3.5%) between it and the other specimen made me re-examine it and I realized it was actually *O. canadensis*.

Material examined. 8♀ and 6♂. **CANADA**. **British Columbia**. Terrace, 11.viii.1960, W.R. Richards (1♂, CNC); Vancouver I., Lake Cowichan, 1.7 km N. of town, 24 and 31.vii.1979, I.M. Smith, sweeping (1♀, 1♂, CNC). **USA**. **Alaska**. 14 km N. Juneau, Mendenhall Valley, Dredge Lake, 17-25.viii.1999, M. Schutz, MT (1♀, UCRC); Valdez, Valdez Glacier Campground, 2.viii.1978, P.H. Arnaud (1♂, CAS). **California**. *Del Norte Co.*: Crescent City, 3.viii.1940, H. & M. Townes (1♀, AEIC); Klamath, coastal trail, 3.viii.1985, L. Masner, sweeping, CNCHYM07505 [barcode failed], CNCHYM07506 (4♀, 2♂, CNC). **Washington**. *Clallam Co.*: Lake Ozette, north shore, 24.vi.1990, J.D. Pinto (3♂, CNC).

Comment. A specimen from North Carolina, Yancey Co., Mt. Mitchell, 6800′, 12.viii.1957, J.G. Chillcott (1♀, CNC) is puzzling. It has no mps on fl_4. Because *O. canadensis* is morphologically close to *O. longipetiolus* I thought perhaps the specimen belonged to the latter species but it does not. More material is needed from North Carolina to determine its status.

Ooctonus fuscipes Whittaker

(Figs. 13, 30, 42, 51, 67, 80, 91, 104, 107, 129, 145, 163, 179)

Ooctonus fuscipes Whittaker, 1931: 189; Peck, 1951: 411 (catalogue); Peck, 1963: 18 (catalogue); Burks, 1979: 1027 (catalogue).

Oöctonus [sic] *fuscipes*; Britton, 1938: 146 (catalogue, misidentification).

Type material. Lectotype ♀ in BMNH (examined), here designated to avoid ambiguity about the status of the type specimens of this species, on card (Fig. 13) labeled: 1."Lectotype [purple edged circle]". 2. "Type [red rectangular label]". 3. "Hollyburn, B.C. 7.IX.28 Coll. O.W.". 4. Canada: O. Whittaker Coll. Per W.H. Storey. B.M. 1947 - 212.". 5. Ooctonus fuscipes Whitt. ♀ Det. O. Whittaker". 6. "B.M. Type Hym. 5.2318". Type in good condition, mounted in dorsal view on card with wings, legs, and antennae spread out.

Paralectotypes. Whittaker stated that he had four specimens of *O. fuscipes*. Two paralectotypes are supposed to be in BMNH but only one of them could be found there. It was examined but is covered in mould; it has the same data as the lectotype but was collected on 4.ix.1929. Its colour, antennal proportions, and as much structure that could

be seen clearly match the lectotype. The paralectotype female in USNM (examined) is mounted in same way as the lectotype and labelled 1. "Paratype". 2. "Paratype No. 43552 U.S.N.M.." 3. "Hollyburn, B.C. 27.VIII.30 Coll. O.W.". 4. "Ooctonus fuscipes Whitt. ♀ Det. O. Whittaker". It is in good condition and also matches the lectotype.

Diagnosis. *Ooctonus fuscipes* females are distinguished from other Nearctic species by the body length more than about 1200 µm, brown legs (Fig. 13), no mps on fl_5 and fl_6 (Fig. 67) and ovipositor not or scarcely exserted.

Ooctonus fuscipes is similar in size and leg colour to *O. arizonensis* and *O. quadricarinatus* but differs by the distribution of mps on the funicle segments (at least 1 mps on fl_5 and fl_6 in the latter two species).

Description. **Female**. Body length 1230–1382 (n=5). Head, antenna except radicle, sometimes scape laterally, and apex of pedicel, mesosoma, and gaster dark brown/orange brown; radicle, apex of pedicel, petiole, and taromeres 1–4, dark yellow. Legs vary from mostly dark brown to mostly yellowish brown, except yellowish joints and tarsomeres 1–4. **Head**. Head (Fig. 30) width 326–365 (n=4). Vertex (Fig. 42-male, 51) without stemmaticum; mid ocellus diameter 33. **Antenna**. Flagellum (Fig. 67) with 2 mps on fl_7 and fl_8, and 7 mps on clava. Fl_7 slightly the longest segment. Fl_1–fl_6 length/width ratios fl_1 2.87–3.29, fl_2 2.75–3.06, fl_3 2.83–3.44, fl_4 2.41–3.23, fl_5 2.64–3.22, fl_6 2.25–3.63; clava 3.62–3.87× as long as wide, slightly longer than fl_6–fl_8 together. Measurements (length/width, n=4): scape 221–248/36–41, pedicel 67–72/34–39, fl_1 60–73/19–26, fl_2 57–63/20–24, fl_3 64–74/21–26, fl_4 57–68/20–24, fl_5 65–74/23–26, fl_6 53–63/24–27, fl_7 69–75/29–36, fl_8 60–68/34–38, clava 202–234/52–65. Total flagellum length 687–791. **Mesosoma**. Pronotum (Figs. 104, 107) with collar wide, moderately long and clearly visible in dorsal view, with well defined carina. Mesonotum (Figs. 104, 107) wide; midlobe of mesoscutum with meshes engraved; scutellar seta long, extending well posterior to medially almost straight frenal line; frenum 0.62–0.66× mesoscutellum length and entirely reticulate. Metanotum with metascutellum faintly reticulate posteriorly. Propodeum (Fig. 129) smooth between carinae and its anterior margin with stub, the latter just lateral to lateral margin of metascutellum; median areole separated from metascutellum by short median carina; plica (Fig. 91-male) straight except anteriorly where curved medially and extending as a short arm to metascutellum just medial to stub but lateral to lateral margin of metascutellum. **Wings**. Fore wing (Fig. 145) length 1345–1561, width 505–610, length/width 2.56–2.77, longest marginal setae 73–91, about 0.15× as long as greatest wing width (n=4). Marginal vein length 150–156. Hind wing (Fig. 145) length 1033–1203, width 171–80, longest marginal setae 115–134. **Metasoma**. Petiole slightly shorter than metacoxa + metatrochanter. Gaster (Fig. 163) with ovipositor length 466–515 (n=4), 0.80–1.00× as long as metatibia.

Male. Body length. 1331–1434 (n=2). Antenna (Fig. 80). Measurements, length (n=2): scape 214–218, pedicel 67–69, fl_1 111–116, fl_2 138–141, fl_3 141–132, fl_4 130–131, fl_5 128–132, fl_6 127–128, fl_7 122–124, fl_8 121–123, fl_9 120–125, fl_{10} 114–116, fl_{11} 113–116. Total flagellar length 1364–1372. Fl_6 length/width 3.74–3.83, with about 8 mps. Mid ocellus diameter 33. Genitalia short (Fig. 179).

Hosts and habitat. Hosts are unknown. Specimens have been collected 31–39m in height in the canopy of ancient (up to 700 years old) Sitka spruce trees or on the forest floor ground cover of Salmonberry, Devil's Club, Alaskan Blueberry and False Azalea in the upper Carmanah Valley.

A few specimens were collected elsewhere in boreal forest, and on ocean side vegetation. The Upper Carmanah Valley sample consisted of several Malaise traps at 30–49 m height in Sitka spruce trees, and at ground level on ancient forest floor, transition zone, and a 4 ha clear cut. The largest number (362 specimens) of a single species of *Ooctonus* from one area that I have seen was collected there. The sex ratio was heavily biased towards males, with only 28.4% females, unlike the situation for most populations of most species of Mymaridae, where females predominate. Interesting location within habitat differences occur between males (n=257) and females (n=97). For females, none (0%) were collected in the canopy, 16 (16.5%) in the transition zone, 10 (10.3%) in the clear cut and 71 (73.2%) on the forest floor. For males, the respective numbers were 176 (68.5%), 36 (14.0%), 10 (3.8%), and 36 (13.6%). Presumably, females remain on the forest floor searching for suitable host eggs, whereas males move into the canopy to disperse. Neither sex was common in clear cut or transitional zone areas. Unfortunately, the hosts and therefore the location of egg deposition are unknown. The other two *Ooctonus* species, *O. notatus* (n=50) and *O. vulgatus* (n=11), collected in Upper Carmanah valley were found almost entirely in the clear cut (55 of 61 specimens or 90.2%). Three males of *O. notatus* (6.0%) were collected in the canopy and four females of *O. vulgatus* (36.4%) were collected in the transition zone. Both these species are found mainly in open habitats, and are almost certainly European introductions. Their presence in a small clear cut area surrounded by ancient forest shows that they (and their hosts) are very capable of dispersing widely, and perhaps quickly, into suitable habitats.

Barcoding. Four specimens yielded barcodes (CNCHYM07499, CNCHYM07501, CNCHYM07502, and CNCHYM07503), showing slight variation between the Oregon and British Columbia specimens.

Material examined. 108♀ and 261♂. **CANADA**. **British Columbia**. Upper Carmanah Valley, 18.viii-9.ix, 10-29.ix CNCHYM07499, 30.ix-16.x.1991, 31–39m [1 ♂ at 42m on 21.ix] up in tree canopy, N. Winchester, MT (103♀, 259♂, CFS-Victoria, CNC); Cassiar hwy. Boyar Lake to Stikine River, 6.viii.1988, S. & J. Peck, boreal forest, car net, CNCHYM07525 [barcode failed] (2♀, 1♂, CNC). **USA**. **California**. *Monterey Co.*: Pfeiffer Big Sur State Park, 1.iv.1985, J.T. Huber, sweeping grasses and vegetation, CNCHYM07500 [barcode failed] (1♂, CNC). **Oregon**. *Benton Co.*: Corvallis, 8.x.1980, H.K. Townes (1♂, AEIC). *Lincoln Co.*: 2 mi. W. Newport, South Beach State Park, 23.viii.1984, M.E. Schauff, P. Hanson, ocean side vegetation, sweeping, CNCHYM07501, CNCHYM07502, CNCHYM07503 (3♀, USNM).

An additional 6 females from South Beach State Park are doubtfully assigned to *O. fuscipes* because they have 2 mps on each of fl_5 and fl_6; four males from this locality and date are also doubtfully assigned to this species.

***Ooctonus hemipterus* Haliday**

(Figs. 1, 31, 43, 52, 62, 68, 81, 92, 105, 108, 130, 146–149, 164, 172, 188)

Ooctonus hemipterus Haliday, 1833: 344; Schmiedeknecht, 1909: 490 (catalogue); Kloet and Hincks, 1945: 305 (checklist, Britain); Kryger, 1950: 78 (list); Bouček and Graham, 1978: 109 (checklist, Britain); Kalina 1989: 127 (checklist, Czechoslovakia); Triapitsyn 2010: 15 (redescription, literature), 18 (records from Canada and USA).

Ooctonus atroclavus Kieffer, 1913: 2; Bouček and Graham, 1978: 109 (checklist, under *hemipterus*).

Ooctonus soykai Hincks, 1952: 154 (key), 160 (description); Bouček, 1977: 122 (list, Yugoslavia); Kalina, 1989: 127 (checklist, Czechoslovakia).

Type material. Lectotype ♀ of *O. hemipterus* in NMID (not examined), designated by Hincks 1952: 158. Synonyms and their types treated by Triapitsyn (2010).

Diagnosis. *Ooctonus hemipterus* is distinguished from other Nearctic species by the entire head and mesosoma (including mesopleuron, prepectus, and all propodeal areoles) covered with reticulate sculpture, thus appearing matte (Figs. 92, 105, 108, 130). Other unusual features are the toruli well separated from the transverse trabecula (Fig. 31), large eye (Fig. 92) (also large in *O. silvensis, O. hemipterus*, and *O. occidentalis*), very low (almost absent) transverse carina dorsally on pronotum, weakly defined femoral depression (mesopleural and transepimeral sutures almost absent) and absence of propodeal stub (also absent in *O. occidentalis*). All other Nearctic *Ooctonus* species have the sides of the mesosoma and the propodeal areoles smooth or almost so, thus appearing quite shiny, and the other features are mostly different. *Ooctonus hemipterus* is most similar to *O. capensis* Huber from South Africa (Huber et al. 2010) but the latter has the propodeum with a stub and the plica is bifurcate at the propodeum, with a long median and short lateral arm (stub absent and plica usually not bifurcate in *O. hemipterus*).

Ooctonus hemipterus is clearly unrelated to the Nearctic species, as might be expected from an Old World introduction. It is also the only *Ooctonus* species whose females may be macropterous, brachypterous or micropterous (Figs. 1, 146–148). Macropterous specimens have a relatively narrow fore wing, in females with the apex slightly truncated apically (Fig. 146) and in males definitely rounded apically (Fig. 149). Both sexes of other species have the forewing relatively wider and more clearly truncated apically.

Description. **Female**. Body length 922–1075 (n=10). Head and mesosoma dark brown, matte, entirely covered with reticulate sculpture; scape except radicle, and pedicel light brown, flagellum brown, petiole, and legs yellow. Forewing with faint brown band just beyond venation and sometimes a faint brown suffusion in apical half of wing beyond venation (Fig. 146). **Head**. Head (Fig. 31) width 287–320 (n=5). Vertex with stemmaticum (Figs. 43, 52). Mid ocellus diameter at most 17. **Antenna**. Flagellum (Fig. 68) with 2 mps on fl_7, 2 on fl_8, and 7 on clava. Fl_1–fl_6 length/width ratios: fl_1 1.78–2.33, fl_2 1.76–1.90, fl_3 1.82–2.05, fl_4 1.63–2.08, fl_5 1.53–2.04, fl_6 1.52–1.73; clava 2.75–3.02× as long as wide, almost as

long as fl_5–fl_8 together. Measurements (length/width, n=5): scape 183–195/31–35, pedicel 56–61/29–32, fl_1 30–35/15–17, fl_2 27–29/15–17, fl_3 31–34/16–18, fl_4 30–32/15–19, fl_5 30–37/18–20, fl_6 34–37/21–22, fl_7 44–47/27–31, fl_8 47–50/34–36, clava 154–161/53–56. Total flagellum length 423–454. **Mesosoma**. Pronotum (Figs. 105, 108) with collar moderately wide, short but visible in dorsal view, without carina. Mesonotum (Figs. 105, 108) wide; midlobe of mesoscutum with meshes strongly raised; scutellar seta short, extending to medially almost straight frenal line; frenum about 0.66× mesoscutellum length and entirely reticulate. Metanotum with metascutellum and lateral lobes reticulate. Propodeum (Fig. 130) entirely covered with reticulate sculpture and its anterior margin without a stub; median areole separated from metascutellum by a median carina (carina sometimes almost absent); plica straight, extending to anterior margin of propodeum, occasionally bifurcate with a short median arm. **Wings**. Fore wing in macropterous form (Fig. 146) fairly narrow, slightly truncate apically, and with a transverse brown band just beyond venation, in brachypterous or micropterous forms with narrow fore wing rounded apically and with venation greater than half wing length (Figs. 147, 148). Length (macropterous form) 926–1004 (n=4), width 279–313, length/width 3.21–3.38, longest marginal setae 68–83, about 0.25× as long as greatest wing width. Hind wing length 752–849, width 32–38, longest marginal setae 93–113. Marginal vein length 123–129. **Metasoma**. Petiole (Fig. 188) reticulate dorsally, about as long as metacoxa. Gaster (Fig. 164, 172, 188) with ovipositor length 406–434 (n=5) 1.12–1.14× as long as metatibia (350–374).

Male. Body length 896–1178 (n=5). Antenna (Fig. 81). Measurements, length (n=5): scape 153–184, pedicel 26–36, fl_1 65–75, fl_2 62–83, fl_3 62–86, fl_4 69–89, fl_5 75–87, fl_6 71–89, fl_7 81–93, fl_8 78–89, fl_9 81–97, fl_{10} 73–89, fl_{11} 74–86. Total flagellar length 1049–1067. Fl_6 length/width 3.38–4.27, with 4 (?5) mps. Forewing (Fig. 149) narrower, length/width 3.86–4.10, and with more rounded apex. Mid ocellus diameter 24–26.

Hosts and habitat. Hosts are unknown. Habitats vary widely. Specimens were collected near water, in water with *Typha* or *Carex*, agricultural areas such as blueberry, onion, alfalfa, clover, and potato fields, apple orchards, prairie remnants, fields, forests, bush, meadows, bogs, sandy areas, urban gardens, cedar swamps, and beach. Several specimens were sifted from duff or litter, including two males (Oxford Mills) in early December, suggesting that they overwinter as adults.

Barcoding. Three of four specimens yielded barcodes (CNCHYM07476, CNCHYM07477, and CNCHYM07478) and one did not (CNCHYM07475). There was slight variation in DNA between the two specimens from Ontario but none between the Quebec specimen and one of the Ontario specimens.

Distribution. *Ooctonus hemipterus* occurs across the Palaearctic region from Ireland to the Kuril Islands (Triapitsyn 2010). In the Nearctic region its presence in Alaska and northern Canada and and apparent absence from southern USA suggests it may be a naturally occurring Holarctic species though it could also have been introduced from Europe into eastern North America by human activity.

Material examined. 183♀ and 330♂. **CANADA**. **British Columbia**. Abbotsford, Aquilini off Ladner road, Pitt Meadows, 49°17.996′N 122°37.865′W, 2.vii.2001, M. Robertson, blueberry field, YPT (4♀, CNC), Vye road, 49° 00.847′N 122° 15.479′W, 7.viii, 4.ix.2001, M. Robertson, blueberry field, YPT (2♀, CNC); Richmond, No. 6 road, 49° 09.481′N 123° 04.188′W, 2.vii.2001, blueberry field, YPT (1♀, CNC). **Manitoba**. Elma, 2 mi. E. on hwy 11, 31.vii.2000, M. Iranpour, pond, YPT (1♂, CNC). **New Brunswick**. *Albert Co.*: Fundy National Park, Chignecto campsite, 45.6032°N 64.9877°W, 12.viii.2009, J. Fernández, (2♂, CNC). *Kent Co.*: Kouchibouguac National Park, 18.v.1977, G.A.P. Gibson (1♂, CNC), 29 and 30.viii, and 12.ix.1977, G.A. Calderwood (3 microp.♀, 1♀, 2♂, CNC), 20 and 21. ix.1977, S.J. Miller (5♀, 12♂, CNC). *Queen's Co.*: 25 km W. Canaan Forks, hwy. 112, 19.viii.1984, M. Kaulbars (2♂, CNC). **Northwest Territories**. Kovaluk River, 69°11′N 131°W, 6-10.vii.1971, W.R.M. Mason (2♂, CNC). **Nova Scotia**. *Kings Co.*: Kentville, 6. xi.1953, C.J.S. Fox, Berlese, apple orchard duff (1 microp. ♀, CNC); Sheffield Mills, orchard, 31.viii.1998, 20.viii.1999, M. Trombley, YPT (3 microp. ♀, 6♂, CNC), *Lunenburg Co.*: North Sawler, 31.viii.1951, K.H. Sanford (1♂, CNC). *Victoria Co.*: 5 km S. Ingonish, Smoke Mt., 275m, 23.viii.1984, M. Kaulbars (1♂, CNC). **Ontario**. Alfred Bog, 13.vii.1981, L. LeSage (1♀, CNC); 3 km N. Almonte, 12-19.viii-1986, J. Denis, L. Dumouchel, YPT (1♂, CNC); 3 km N. Almonte, 12-19.viii, 17-24.ix.1986, J. Denis, L. Dumouchel, YPT (4♂, CNC), 5 km NW. Almonte, 22-29.vii.1986, H. Goulet (3♂, CNC); Ancaster, 3-15.x.1994, H. Goulet, prairie remnant (3♂, CNC); near Ancaster, 43°15′N 80°00′W, 2.vi-1.vii, 7-28. vii.1995, B. DeJonge, bush/prairie, MT (1♀, 1♂, CNC); Buckham's Bay, 45.4985°N 76.1108°W, v-x.2010, J. Read, CNCHYM07478 (1♂, CNC); 7 mi. SW. Carleton Place, S. Miller's farm, 27.v-2.vi.1980 (2♂, CNC), viii-ix, 1-30.x.1991, YPT in pond with *Carex* (3♂, CNC); Chatterton, 13 mi. N. Belleville, 27.x.1969, C.D. Dondale, meadow (1 microp.♀, CNC); near Clayton, 12.viii.1981, L. Masner, H. Goulet, forest, sweeping (1♀, CNC); Crieff Bog, 3 km W. Puslinch, 28.v-4.vi.1987, D. Blades, mid-forest pool, YPT (2 microp.♀, CNC); Constance Bay, 12-19.x.1973, G. Gibson, YPT (3♂, CNC), 26.viii-7.ix.1983, M. Sanborne (1♀, CNC); Elmira, Salem Creek, 1-31.viii.1977, L. LeSage (2♂, CNC); near Embro, 43°12.362′N 80°55.713′W, 7-21.ix.2006, B. Broadbent, pitfall under spruce hedgerow near alfalfa field (2 microp.♀, CNC); Flint Hill, near Kemptville, 30.viii-6. ix.1983, L. Dumouchel (1 microp.♀, CNC); Gananoque, 24.viii-12.x.1977 (7 microp.♀, 5♂, CNC); 18 km E. Gananoque, 12.v-9.vi.1977, C. Dondale, J. Redner, pitfall in old field (10 microp.♀, CNC); Gloucester, 4-17.x.1984, M. Sanborne (3♂, CNC); Guelph, 1-20. vii.1982, K.N. Barber (2♂, CNC); Hamilton, 6 and 18.viii.1980, 2-7.viii, 14-22.viii, 28. vii-1.viii, 31.viii-7.ix, 25.x-8.xi, 30.ix-11.x.1981, M. Sanborne (1 microp.♀, 4♀, 9♂, CNC); Innisville, 29.vii.1963, (1♂, CNC); Leitrim, 16-23.ix, 13-20.x.1985, R.E. Skidmore, MT (3♂, CNC); London, 1-17.ix.1982, A. Tomlin, pine hedgerow (1♀, CNC), Fanshawe Experimental Farm, 10-31.vii, 5.ix-2.x.1981, 4-25.viii, 31.ix., 8-12.x, 5.xi.1982, A. Tomlin, onion field (2♀, 6♂, CNC), 5-30.vii.1982, L. Masner (1♀, CNC); Marmora, Crow Lake, 20.viii.1975, L. Masner, R. Longair (2♂, CNC); Milton, 8-13.viii.1981, M. Sanborne (1♀, 1♂, CNC); Nepean, Pine Glen, 3-10, 12-14 and 22-26.x.1991, 16.viii-7.ix.1992, 24-30.x.1994, 27-30.vii.1999, L. Masner (4 microp.♀, 2♀, 3♂, CNC), Slack Road, 2.x, 4-5.x.2007, 1 and 6-9.xi.1999, L. Masner, YPT, sandy area (5♂, CNC); Ottawa, 23-30. ix.1985, H. Goulet, garden (1♂, CNC), 20-27.ix.2008, L. Masner, MT, CNCHYM07476 (1♀, CNC), 30.x.1988, 1-3.ix.1989, 10 and 27.x.1992, 20.x.1995, J.R. Vockeroth, *Typha* on

pond/YPT among *Typha* (14 microp.♀, 4♂, CNC), airport, 20-27.ix.1985, L. Dumouchel, YPT (3♂, CNC), airport road, 1-8.xi.1985, L. Masner, (1♂, CNC); airport sands, 11-18. ix.1985, J. Denis (2♂, CNC), 23-30.ix, 1-16.x, 17.x-7.xi.1985, 20.vii-10.viii, 26.viii-7. ix.1986, 20-31.vii, 14-21.viii, 19.ix-8.xi, 20-27.ix, 27-30.x.1987, 17-20.vii, 5-8.x, 10-13.x.2008, H. Goulet, city/urban garden, 45°21.365′N 75°42.416′W, YPT and MT (11 microp.♀, 1♀, 53♂, CNC), Jock River, 4-5.x.2007, L. Masner (4♂, CNC), Mer Bleue, 16-23.viii.1982, H. Goulet (1♀, CNC), 2.x.2000, L. Masner, sweep (1 microp.♀, 2♂, CNC), along Ottawa River shoreline, 19-20.ix.2007, L. Masner (1♀, CNC), Riverfront Park, 13. ix.2000, L. Masner, YPT (1♂, CNC); Rockland Park, 9.xi.2005, YPT under *Erigeron*, J.R. Vockeroth (1 microp.♀, 4♂, CNC), Tanglewood road, 14.ix-2.x.1978, L. Masner, YPT (1♂, CNC); Oxford Mills, edge of Little Rideau River, 17.viii.1971, 3-10, 10-17 and 17-24.viii, 7-21.ix, 21-28.ix, 28.ix-12.x.1973, L. Masner, YPT (22 microp.♀, 2♀, 17♂, CNC), 4. xii.1973, sifted from litter, L. Masner (2♂, CNC), 17 and 21.viii.1978, N. Tulsiram (3 microp.♀, 7♂, CNC), 31.viii, 22.ix-3.x.1978, G. Gibson, YPT (4 microp.♀, 6♂, CNC); Point Pelee, 22.viii.1984, A. Borkent (1♀, CNC); Saugeen Bluffs Conservation Area, near Paisley, 19.v-16.vi.1988, C. Dondale, J. Redner, pitfall trap in cedar swamp (1 microp.♀, CNC); Shaw Forest, 10 km N. Eganville, edge of beaver pond, 6-13.viii.1992, M.J. Sharkey (1♀, 1♂, CNC); 5 km E. Eganville, 30.vi.1992, H. Goulet (1♀, CNC), 1-8.x.1992, M. Sharkey, MT (1♂, CNC); Shirley's Bay, 15 km W. Ottawa, 16-31.vii.1984, M. Kaulbars (1 microp.♀, 1♂, CNC), 12-19.viii, 29.vii-5.viii.1985, M. Sanborne, L. Leblanc (4♀, 2♂, CNC), 7-14.viii.1985, M. Sanborne, L. Dumouchel, (4♀, CNC), 3-10.x.1985, J. Denis (1 microp. ♀, 1♀, CNC), Innes Point [Shirley's Bay], 25.x-5.xi.1986, J. Denis, MT (1♂, CNC); Spencerville, 14-21.viii.1979, L. Masner (1♀, CNC); St. Lawrence Islands National Park, summer, 1975 (3♂, CNC), Grenadier Island, 16-30.viii.1994, CNC Hym. team, *Carya* grove, YPT (1 microp.♀, CNC), Grenadier Island Centre, 30.vii, 7.viii.1975, E. Sigler (4♂, CNC); McDonald Island, 9 and 11.ix, 1, 4, and 6.x.1976, W. Reid (42♂, CNC), Thwartway Island, 30.viii.1976, Reid (1♂, CNC); Stittsville, 24.ix.1976, M. Sanborne (1♂, CNC), 29-31.viii.1978, MT (1♂, CNC); Thunder Bay, Law road, Powells Lakes, 16 and 29.viii.1980, intercept trap/sweeping, M. Kaulbars, CNCHYM07475 [barcode failed] (1 microp.♀, 13♀, 12♂, CNC); Toronto, Etobicoke, Etienne Brulé Park, 17-19.viii.1998, S. Libenson, mixed forest, deadwood (1♀, CNC); Waterloo, 4.ix.1977, L. LeSage, MT (1♀, CNC). **Quebec**. 6 km N. Bouchette, Lac Roddick (= Lac Ronde), 46°15′21.4″N 75°54′44.2″W, 18..ix, 1-3.x.2005, L. Masner, YPT (2♂, CNC), 27-29.vii.2001, L. Masner, YPT (1♂, CNC), 24-25.ix.2007, L. Masner, riverine (1♂, CNC), 15-17.viii.2009, L. Masner, YPT (1♀, 1♂, CNC); Eardley, junction hwy 148 & Eardley-Masham road, 2-20.viii.1992, CNC Hym. team (1♀, CNC); Gatineau Park, 4.x.1976, G. Gibson, L. Masner (5♂, CNC), 11-20. viii.1991, K. Yamagishi, YPT (2 microp.♀, CNC), 2 km W. chemin Pilon, 23-29.ix, 21-27.x.1992, CNC Hym. team (1 microp.♀, 1♂, CNC), summit of King Mt., 1150′, 16.x.1968, J.F. McAlpine (1♂, CNC), 10.x.1961, J.R. Vockeroth (1♂, CNC), 23.viii.1981, L. Masner (1♂, CNC); Hull (= Gatineau), 23.viii, 19.x.1983, L. Dumouchel, flood forest, flood plain, YPT (1 microp.♀, 1♀, 1♂, CNC), boulevard Fournier, 28.viii-4.ix.1984, J. Denis, L. Dumouchel (1 microp.♀, CNC); Luskville Falls, 300m, 22-29.vii, 5-12.viii, 17-25.ix.1986, J. Denis, L. Dumouchel, MT (4♀, 3♂, CNC), 25.viii-2.ix.1986, YPT in blueberry field in oak-conifer forest clearing, J. Denis, L. Dumouchel, YPT (1♂, CNC); 1 km N. La Corne, 22.vi.2005, 48°24′19.4″N 78°00′11.9″W, H. Goulet, C. Boudreault, fallow field by road,

CNCHYM07477 (2♂, CNC); Old Chelsea, 3.ix.1958, S.M. Clark (1♂, CNC). **Prince Edward Island**. *Queens Co.*: Brackley Beach near Stanope 17.viii.1988, C.M. Yoshimoto, sweeping (3♂, CNC); Harrington, 10-22 and 22-29.viii.1988, 7-21 and 23.vii-28.viii.1989, M.E.M. Smith, potato field, YPT (1 microp.♀, 6♀, 8♂, CNC), 7.ix.2006, pitfall trap in potato field (1♂, CNC), 22.viii and 5.ix.2006, pitfall trap barley/red clover field and clover field (2 microp.♀, CNC). **Saskatchewan**. S. of Moosomin Piperstone Creek, 570m, 50° 01.97′N 101°40.61′W, H. Goulet, C. Boudreault, J. Fernández, prairie (1♀, CNC). **USA**. **Alaska**. Cantwell, Denali hwy, route 8, mi. 85-130, 24.vii.1984, S. & J. Peck, taiga-tundra, car netting (1♂, CNC); Murphy Dome, 64°57.157′N 148°21.331′W, 892m, 20.vii.2009, H. Goulet, C. Boudreault, tundra (2♂, CNC); Tok, 21.vi-15.vii.1984, S. & J. Peck, FIT (1♂, CNC). **Massachussetts**. *Barnstable Co.*: Cape Cod, 16.viii.1977, W.A. Attwater (1♀ microp., CNC) Eastham, 23.ix.1992, J.R. Vockeroth (1♂, CNC). *Hampden Co.*:Westfield, 30.ix.1992, J.R. Vockeroth, pan traps in *Typha* (1♂, CNC). **Michigan**. *Livingston Co.*: Edwin S. George Res., 13.ix.1973, G. Gibson (1♂, CNC). **New Hampshire**. *Coos Co.*: 8 km S. Gorham, 30.viii.1984, M. Kaulbars (1♂, CNC); Mt. Washington, 1370m, 9-13. [month illegible].1983, L. LeSage, E. Rickey, litter (1♀, CNC). **New York**. *Essex Co.*: 10 mi. SE. Lake Placid, Adirondack Park, Heart Lake, 17-18.viii.1987, J. Cumming (1♀ microp., CNC). *Dutchess Co.*: Amenia, 7-12.ix.1982, (1♂, CNC). *Tompkins Co.*: Ithaca, N. shore of Beebe Lake, 20-26.vii, 24-31.vii, and 2.viii.1977, N.F. Johnson, yellow pan traps (8♂, CNC), Ithaca, 14-21.vii.1978, N.F. Johnson (5♂, CNC). **North Carolina**. *Jackson Co.*: near Highlands, Whiteside Mt., 1600m, iv,-20.vii. oak forest, Malaise trap, CNC Hym. Team (1♂, CNC). **Wisconsin**. *Milwaukee Co.*: Milwaukee, Bayside, corner of Brown Deer & N. Rexleigh roads, 2.ix.1983, J.T. Huber (2♂, CNC).

Ooctonus longipetiolus Huber, sp. n.

(Figs. 9, 21, 32, 53, 69, 82, 93, 109, 112, 131, 150, 165, 173, 184)

Type material. Holotype ♀ in CNC, on slide (Fig. 21) labelled 1. "Canada: ON, Nepean, Slack Road, 9.xi.1999, sands, L. Masner, YPT". 2. "Ooctonus longipetiolus Huber Holotype ♀ dorsal".

Paratypes. 59♀ and 26♂. **CANADA**. **Ontario**. Ancaster, 30.ix-12.x.1991, marsh, B. DeJonge (1♂, CNC), 4-11.vi, and 25.vi-1.vii, B. DeJonge, prairie remnant (4♀, 1♂, CNC); near Ancaster, 43°15′N 80°00′W, 7-28.vii.1995, B. DeJonge, bush/prairie (1♀, CNC), 27.v-4.vi.1994, B. DeJonge, prairie, MT (1♀, CNC); Constance Bay [near Ottawa], 22-28.ix.1973, G. Gibson, PT (1♀, CNC); Hamilton, 2-7.viii.1980, M. Sanborne, MT (2♀, CNC), 14-19.vii.1981, CNCHYM07515 [barcode failed], M. Sanborne (1♂, CNC); London, 1-17.ix.1982, A. Tomlin, pine hedgerow (1♀, CNC); Malacoff, 22-28.vii.1985, R. Foottit, YPT (1♀, CNC); Ottawa, same data as holotype (7♀, 2♂, CNC), same data as holotype but 1.xi and 6-9.xi.1999 (7♀, 1♂, CNC); Shaw Forest near Eganville, 27.viii-3. ix.1992, M. Sharkey, MT (1♂, CNC); Shirley's Bay [E. of Ottawa], 27.viii-10.ix.1985, M. Sanborne, H. Goulet (1♀, CNC); Thunder Bay, Law Road, Powell Lakes, 16.viii.1980, M. Kaulbars (2♂, CNC). **Quebec**. Cap Rouge [near Quebec City], 3.viii.1955, O. Peck (1♀, CNC); Luskville Falls top, Gatineau Park, 11.ix.1985, H. Goulet (1♂, CNC); Mont Pinnacle, near Frelighsburg, 20.vi.1991, M. Sharkey (1♂, CNC). **Prince Edward Island**. Millvale, 30.viii.1992, J. Heraty, deciduous forest along river (1♀, UCRC); 1 km SE.

Stanley Bridge, 30.viii.1992, J. Heraty, scrub/goldenrod/apple (1♂, CNC). **USA. Florida**. *Baker Co.*: Glen St. Mary, 30°18′00″N 82°00′55″W, 14.xii.2006, 22.iii, 3.v, 14.vi.2007, E. Zoll, S. Fullerton, MT, rural yard/mixed woods (2♀, 2♂, UCFC). *Highlands Co.*: Archbold Biological Station, 29.v.1991, J.B. Woolley (1♂, CNC). *Marion Co.*: Ocala National Forest, Alexander Spring, 18.ix.1987, L. Masner, hardwood forest, sweep (1♀, 4♂, CNC). *Orange Co.*: Apopka, Rocksprings, Kelly Park, 7.iii.1975, W.R.M. Mason (2♀, 1♂, CNC). *Seminole Co.*: Longwood, 4-8.iii.1975, W.R.M. Mason (1♂, CNC). **Maine**. *Washington Co.*: 5 km E. Wesley, hwy 9 at East Machias road, 29.viii.1984, M. Kaulbars (1♀, CNC). **Maryland**. *Montgomery Co.*: Potomac River Trail, mouth of Seneca Creek, 16.vi.1985, L. Masner, undergrowth by old canal (1♀, CNC). *Prince Georges Co.*: 2 mi. S. Laurel, 18-30.vi.1986, M.E. Schauff (1♀, USNM); Patuxent Wildlife Research Center, 22.vi.1980, G. Gibson (1♀, 1♂, CNC). **Missouri**. *Wayne Co.*: Williamsville, 21.x-11.xi.1987, J.T. Becker, MT (1♀, CNC). **North Carolina**. *Jackson Co.*: Whiteside Mountain, near Highlands, 1600m, iv-20. vi.1987, MT, oak forest, CNC Hymenoptera team (1♀, CNC). **South Carolina**. *Dorchester Co.*: Francis Beidler Forest near Harleyville, 1-22.ix.1987, L. Masner (3♀, 1♂, CNC). **Virginia**. *Clarke Co.*: 2 mi. S. Boyce, University of Virginia, Blandy Experimental Farm, 19-30.vi.1990, D.R. Smith, MT (2♂, USNM). *Hardy Co.*: 3 mi. NE. Mathias, 38°55′N 78°49′W, 17.iv-3.v, 17.v-3.vi, 4-17.vi, 18.vi-18.vii CNCHYM07516, 22.vii-13.ix, 10-30. viii.2002, D.R. Smith, MT (11♀, 2♂, CNC, UCR). *Louisa Co.*: 4 mi. S. Cuckoo, 26.vi-5. vii.1987, 15.ix-7.x.1988, J. Kloke, D.R. Smith, MT (2♀, USNM). *Page Co.*: Shenandoah National Park, Big Meadows, 14.vi.1982, H. Goulet, sweeping various plant communities in meadow (1♀, CNC).

Diagnosis. *Ooctonus longipetiolus* is distinguished from other Nearctic species by the combination of vertex with stemmaticum (Fig. 53), mesoscutum with median longitudinal groove usually extending almost length of midlobe (Fig. 109, 112), transepimeral suture not joining mesopleural suture dorsally, so femoral depression open above (Fig. 93), propodeum with pentagonal areole separated from metascutellum by a median carina about as long as areole and plica bifurcate with long arms (Fig. 131), and gastral petiole longer than metacoxa + metatrochanter (Fig. 165); fl_4–fl_8 each with 2 (rarely 1 on fl_4) mps, clava relatively long and funicle segments relatively short (Fig. 69).

Ooctonus longipetiolus is similar to *O. canadensis* in that both share most of the above features. They differ in antennal proportions: *O. canadensis* has relatively longer funicle segments and a relatively shorter clava that *O. longipetiolus*, and in head shape: shorter and wider in *O. longipetiolus* (Fig. 32) compared to *O. canadensis* (Fig. 29). *Ooctonus longipetiolus* is also remarkably similar to *O. sublaevis* Förster from Europe, which seems to have all but one of the diagnostic features—the median longitudinal groove on the mesoscutal midlobe is absent (Triapitsyn 2010), and the body is smaller (the femoral groove and sutures were not described). Five other *Ooctonus* species in the Palaearctic and Oriental regions have a long longitudinal groove on the mesoscutal midlobe (Triapitsyn 2010). Two specimens from Alabama and Florida (UCRC) have a larger pentagonal areole and shorter gastral petiole so are not included in the type series. Whether they represent variants of *O. longipetiolus* or a different species is uncertain.

Derivation of specific epithet. The name refers to the unusually long gastral petiole.

Description. Female. Body length 1050–1382 (n=20). Head and mesosoma dark brown, gaster and flagellum except fl_1 brown, pedicel dorsally and procoxa light brown; scape, pedicel except dorsally, fl_1, and legs except procoxa uniformly bright yellow to mainly brown (except joints), especially on metafemur and metatibia; petiole even ligher yellow than legs. **Head**. Head (Fig. 32) width (n=3) 337–344. Vertex (Fig. 53-male) with stemmaticum. Mid ocellus diameter 27–31. **Antenna**. Flagellum (Fig. 69) with 2 (occasionally 1) mps on fl_4, 2 mps on each of fl_5–fl_8, and 7 mps on clava. Fl_4 slightly the longest funicle segment. Fl_1–fl_6 length/width ratios: fl_1 2.66–4.09, fl_2 3.03–3.81, fl_3 2.73–3.24, fl_4 2.57–3.30, fl_5 2.11–3.06, fl_6 1.82–2.89; clava 3.75–5.52× as long as wide, very slightly shorter than fl_6–fl_8 together. Measurements (length/width, n=5): scape 216–224/31–36, pedicel 61–65/33–38, fl_1 62–72/18–24, fl_2 68–77/20–24, fl_3 67–77/21–25, fl_4 72–83/24–29, fl_5 70–80/26–34, fl_6 66–79/27–36, fl_7 68–77/29–35, fl_8 67–77/29–38, clava 197–228/41–52. Total flagellum length 735–850. **Mesosoma**. Pronotum (Figs. 109, 112) with collar wide, long and clearly visible in dorsal view, with well defined carina. Mesonotum (Figs. 109, 112) wide; midlobe of mesoscutum with meshes engraved and with longitudinal median groove; scutellar setae long, extending well beyond medially slightly concave anterior margin of frenum; frenum short, at most 0.60× mesoscutellum length and entirely reticulate. Metanotum with metascutellum smooth. Propodeum (Fig. 131-male) smooth between carinae and its anterior margin with a stub just lateral to lateral margin of metascutellum; median areole short, about as long as wide, separated from metascutellum by a long median carina extending to metascutellum; dorsolateral areole with a thin, broken carina close to and parallel with anterior and median margin; plicae straight, not extending to metascutellum and widely bifurcate anteriorly as two long lateral arms, the lateral one longer than the median one. **Wings**. Fore wing (Fig. 150) length 1310–1405, width 461–514, length/width 2.61–2.85, longest marginal setae 67–81, about 0.18× as long as greatest wing width (n=5). Hind wing (Fig. 150) length 935–1011, width 50–67, longest marginal setae 80–94. **Metasoma**. Petiole long (Fig. 165), extending distinctly beyond apex of metacoxa + metatrochanter. Gaster (Fig. 165, 173) with ovipositor length (n=5) 313–343, 0.68–0.72× as long as metatibia (461–480).

Male. Body length. 998–1408 (n=5). Entire flagellum brown. Antenna (Fig. 82). Measurements (n=3): scape 132–172, pedicel 48–54, fl_1 90–122, fl_2 101–139, fl_3 99–135, fl_4 98–129, fl_5 97–129, fl_6 98–129, fl_7 100–130, fl_8 100–128, fl_9 101–128, fl_{10} 101–121, fl_{11} 97–121. Total flagellar length 1090–1412. Fl_6 length/width 2.85–3.21, with 9 or 10 mps. Mid ocellus diameter 31–33. Genitalia fairly narrow for anterior half of length (Fig. 184).

Barcoding. Two of three specimens yielded barcodes (CNCHYM07514-Ontario, CNCHYM07516-Virginia); the third did not (CNCHYM07515-Ontario). Based on the DNA two species are involved. Upon rechecking the Ontario specimen I realized I had misidentified the Ontario specimen (it is much smaller than *O. longipetiolus* specimens). It does not fit the other described species so it is placed under Unassigned species (below).

Hosts and habitat. Hosts are unknown. The habitats are varied: marsh, prairie remnant, bush/prairie, pine hedgerow, oak forest, undergrowth by old canal, plant communities in meadow.

Ooctonus notatus Walker

(Figs. 33, 44, 54, 55, 70, 83, 110, 113, 132, 151, 166, 174)

Ooctonus notatus; Walker, 1846: 50; Dalla Torre, 1898: 430 (catalogue); Schmiedeknecht, 1909: 490 (catalogue); Kloet and Hincks, 1945: 305 (checklist, Britain); Triapitsyn 2010: 28 (redescription, literature), 30 (records from USA).

Ooctonus heterotomus Foerster, 1847: 201; Kalina 1989: 127 (checklist, Czechoslovakia). Synonymy under *O. notatus* by Graham, 1982: 226.

Ooctonus auripes Whittaker, 1931: 190 (in part); Triapitsyn, 2010: 28 (see also under *O. vulgatus*).

Type material. Lectotype ♀ of *O. notatus* Walker in NMID (not examined), designated by Graham 1982: 226. Synonyms and their types treated by Triapitsyn (2010).

Paralectotype. One ♀ of *O. auripes* in USNM (examined), on card and mounted in same manner as lectotype of *O. auripes* and labelled 1. "Paratype". 2. "Paratype No. 43553 U.S.N.M.." 3. "Chilliwack, B.C. 4.IX.26 Coll. O.W.". 4. "Ooctonus auripes Whitt. ♀ Det. O. Whittaker". 5. "= Ooctonus notatus Walker Det. S.V. Triapitsyn 2008". The paralectotype is mounted in the same way as the lectotype but the right antenna is missing fl_{6-8} and the left antenna is missing the apical half of the clava. I agree with Triapitsyn (2010) that the paralectotype is a specimen of *O. notatus*. However, the lectotype of *O. auripes* (BMNH) belongs to *O. vulgatus* (see below under *O. vulgatus*).

Diagnosis. *Ooctonus notatus* is distinguished from other Nearctic species by the combination of body length less than 1000 µm, fl_6 distinctly shorter and narrower than fl_5 or fl_7, and without mps, mesoscutellum entirely reticulate, and propodeum with median areole joined directly to propodeum.

Ooctonus notatus is most similar to *O. silvensis* and *O. vulgatus*. All are small species with a short pronotum and gaster and without mps on fl_1– fl_4. *Ooctonus notatus* is distinguished from these and perhaps other Nearctic species by the presence of 2 mps on fl_5, fl_7, and fl_8 (Fig. 70) (fl_5 without mps in *O. silvensis* and *O. vulgatus*), the frenum with reticulation over the entire surface (Fig. 110, 113) (smooth or almost so medially in *O. silvensis* and *O. vulgatus*), and propodeum with a large median areole not separated from metascutellum (Fig. 132). A median areole joined anteriorly directly to the propodeal margin also occurs in *O. vulgatus* but *O. vulgatus* has a shorter marginal vein.

Description. Female. Body length 742–922 (n=10). Head and mesosoma dark brown, metasoma brown, sometimes reddish brown; radicle, scape and pedicel laterally and petiole yellow; legs except apical tarsomere of each leg usually uniform light yellow, rarely with slight brown infuscation on femora and tibiae. **Head**. Head (Fig. 33) width 277–287 (n=3). Vertex (Fig. 44, 55-male) without stemmaticum. Mid ocellus diameter about 19. **Antenna**. Flagellum (Fig. 70) with 2 mps on fl_5, fl_7 and fl_8, and 7 mps on clava. Fl_5 the longest segment; Fl_1–fl_6 length/width ratios (n=3): fl_1 2.49–2.90, fl_2 2.23–2.59, fl_3 2.17–2.66, fl_4 1.84–2.17, fl_5 1.89–1.90, fl_6 1.58–1.94; clava 2.76–3.52× as long as wide, slightly shorter than fl_4–fl_8 together. Measurements (length/width: scape 173–179/31–32, pedicel 56–57/31–32, fl_1 44–46/16–18, fl_2 40–43/17–18, fl_3 42–47/18–20, fl_4 35–38/17–19, fl_5 53–56/27–28, fl_6 36/19–23, fl_7 49–53/24–30, fl_8 46–47/32–35, clava 161–168/47–59. Total

flagellum length 500–534. **Mesosoma**. Pronotum (Figs. 110, 113) wide, with collar short and scarcely visible in dorsal view, with well defined carina. Mesonotum (Figs. 110, 113) very wide; midlobe of mesoscutum with meshes raised anteriorly, engraved posteriorly; scutellar seta short, extending just posterior to medially slightly concave frenal line; frenum about 0.79× mesoscutellum length, and entirely reticulate. Metanotum with metascutellum smooth. Propodeum (Fig. 132) smooth between carinae and its anterior margin with stub just lateral to lateral margin of metascutellum; median areole joined to metascutellum by united carinae of dorsolateral areoles; plica straight, not (or scarcely) bifurcate anteriorly, extending to apex of stub. **Wings**. Fore wing (Fig. 151) length 911–939, width 329–350, length/width 2.68–2.80, longest marginal setae 52–60, about 0.17× as long as greatest wing width (n=3). Hind wing (Fig. 151) length 689–710, width 38–41, longest marginal setae 79–101. **Metasoma**. Petiole shorter than metacoxa + metatrochanter. Gaster (Fig. 166, 174) with ovipositor length 376–442 (n=3) 1.15–1.29× as long as metatibia (326–335).

Male. Body length 845–922 (n=2). Legs mainly brown. Antenna (Fig. 83). Measurements, length (n=2): scape 143–159, pedicel 50–56, fl_1 76–85, fl_2 89–91, fl_3 89–92, fl_4 90–92, fl_5 91–93, fl_6 86–89, fl_7 75–93, fl_8 92–93, fl_9 91–92, fl_{10} 87–95, fl_{11} 87–98. Total flagellar length 959–1007. Fl_6 length/width 3.31–3.33 and with 6 mps. Mid ocellus diameter 24.

Barcoding. Three of five specimens yielded barcodes (CNCHYM07459, CNCHYM07461, and CNCHYM07462) and two did not (CNCHYM07460 and CNCHYM07463). There was little variation among the specimens despite the geographic range covered (Alberta, Ontario, and Prince Edward Island.)

Hosts and habitat. Hosts are unknown. Specimens have been collected in a fallow field, old field, turnip [rutabaga] field, potato field, and orchard. Some specimens may have come from more natural habitats (less disturbed by mankind).

Material examined. 69♀ and 114♂. Six specimens reported by Triapitsyn (2010) from Montana and Washington were also examined, confirming his identifications. Their collection data are not duplicated here. Specimens from Alaska, California, and Oregon (Triapitsyn 2010) were not examined but represent additional state records. **CANADA**. **Alberta**. Beaverlodge area, Saskatoon Mt., 962m, 55°13.20′N 119°16.92′W, 2.viii.2007, J. Otani, natural meadow, sweeping, CNCHYM07462 (1♂, CNC). **British Columbia**. Shushwap Lake, Blind Bay, 15-31.viii.1986, C.A. Elsey, MT, CNCHYM07460 [barcode failed] (1♂, CNC); Upper Carmanah Valley, 31.vii-11.viii, 12-27.viii, 28.viii-9.ix, 10-29.ix, 30.ix-16.x, 17-26.x.1991, N. Winchester, MT (15♀, 33♂, CFS-Victoria). **New Brunswick**. Fundy National Park, Chignecto campsite, 45.6032°N 64.9877°W, 12.viii.2009, J. Fernández, roadside, MT (2♀, CNC); Parker Ridge, Forest Insect Survey, 53-18C14, 5.viii.1953 (2♀, 1♂, CNC). **Nova Scotia**. Bridgetown, 7.x.1912, 20.vii, 26.vii, 5.xi, 16.xi, 1.x.1913, G.E. Saunders (3♀, 38♂, USNM). **Newfoundland**. Cornerbrook, 48°57.355'N 57°54.681'W, 17.vii.2008, H. Goulet, C. Boudreault, fallow field (2♀, 5♂, CNC). **Nova Scotia**. Cape Breton Highlands National Park, Pleasant Bay, 24.vii.1983, L. Masner (3♀, CNC). **Ontario**. Buckham's Bay, 45.4985°N 76.1108°W, v-x.2010, J. Read, MT, CNCHYM07459 (1♀, CNC); Hamilton, 28.vii-1.viii.1981, M. Sanborne, MT (3♀, CNC); Island Falls, 23.viii.1959,

S.M. Clark (1♀, CNC); London, Fanshawe Experimental Farm, 9-12.1982, L. Masner, turnip field (2♀, CNC), and 5-30.vii.1982, L. Masner (1♀, CNC); Ottawa, 45°21.365′N 75°42.416′W, 5-8.x.2008, H. Goulet (1♀, CNC); Thunder Bay, Powells Lakes, 10.5 km NE. Lake Superior, Law road, 16.viii.1980. M. Kaulbars, sweeping, CNCHYM07463 [barcode failed] (1♂, CNC). Waterloo, 4.ix.1977, L. LeSage (1♀, CNC). **Prince Edward Island**. Charlottetown, 4-18.viii.1991, M.E.M. Smith, rutabaga field, YPT, (1♀, CNC); Harrington, 18-22.viii.1988, 18-24.vii, 23.vii-8.viii, 7-21.viii.1989, M.E.M. Smith, potato field, YPT (5♀, 1♂, CNC); North Tryon, 7.viii.1991, M.E.M. Smith, potato field, YPT (1♀, CNC); near Stanope, Brackley Beach,17.viii.1988, C.M. Yoshimoto, sweeping, CNCHYM07461 (1♀, CNC). **Quebec**. Belle-Anse, 48°37.50′N 64°10.70′W, 26.vii.2008, H. Goulet, C. Boudreault, A. Badiss, fallow field, sweeping (3♀, 1♂, CNC); Frelighsburg, 8.viii.1995, N. Bostanian, orchard, YPT (1♀, CNC); Lac Chicobi, 18.viii.1971, A. Sauvé, MT (3♀, CNC). **USA**. **New York**. *Herkimer Co.*: 9 mi. N. Herkimer, no date, N.F. Johnson, old field, MT (2♀, 1♂, CNC). **Ohio**: *Portage Co.*, Nelson & Kennedy State Res., 9.viii.2003, T. Pucci (1♀, CLEV). **Virginia**. *Page Co.*: Shenandoah National Park, Big Meadows, 1006m, 19.ix.1980, L. Masner, B. Bowen (2♀, 19♂, CNC), 8.vii.1987, G. Gibson (2♂, CNC), 8.vii.1987, 1300m, J. T. Huber, sweeping (6♀, 5♂, CNC). **Washington**. *Clallam Co.*: Olympic National Park, 4 mi. S. Elwha [River], 15.viii.1985, A.T. Finnamore, T. Thormin (2♀, CNC). *Pacific Co.*: 6 mi. N. Raymond, 19.vii.1988, J.D. Pinto (1♀, CNC). *Pierce Co.*: Ashford, 1-14.viii.1985 (1♀, CNC). *Thurston Co.*: Kalispell, 30.vii.1988, H.E. Andersen (6♂, UCRC).

Ooctonus occidentalis Whittaker

(Figs. 14, 34, 45, 56, 71, 84, 111, 114, 133, 152, 167, 175, 180)

Ooctonus occidentalis Whittaker, 1931: 191; Peck, 1951: 411 (catalogue); Peck, 1963: 19 (catalogue); Burks, 1979: 1027 (catalogue).

Ooctonus insignis Haliday: Triapitsyn, 2010: 23, 47 (misidentifications). The two female specimens from Alaska in CAS, one of which bears a 2009 identification label by Triapitsyn reading "*Ooctonus ?insignis*" and incorrectly published as *O. insignis* [without the question mark], are both *O. occidentalis*.

Type material. Lectotype ♀ in BMNH (examined), here designated to avoid ambiguity about the status of the type specimens of this species, on card (Fig. 14) labelled 1. "Lectotype [purple edged circle]". 2. "Type [red rectangular label]". 3. "Hollyburn, B.C. 31.VIII.30 Coll. O.W.". 4. Canada: O. Whittaker Coll. Per W.H. Storey. B.M. 1947 - 212.". 5. "Ooctonus occidentalis Whitt. ♀ Det. O. Whittaker". 6. "B.M. Type Hym. 5.2321". The lectoype is mounted face down on the card with wings, legs, and antennae (dorsal view) spread out.

Paralectotype. One female in USNM (examined), on card and mounted in same manner as lectotype, and labelled 1. "Paratype". 2. "Paratype No. 43554 U.S.N.M.." 3. "Hollyburn, B.C. 18.VII.28 Coll. O.W.". 4. "Ooctonus occidentalis Whitt. ♀ Det. O. Whittaker".

Diagnosis. *Ooctonus occidentalis* is distinguished from other Nearctic species by the combination of fl_5–fl_8 each with 2 sensory ridges, vertex with stemmaticum, propodeum without spur, pentagonal areole with anterior median carina gradually and smoothly bifurcating posteriorly, and plica clearly and uniformly bowed outwards and meeting propodeal margin well within lateral margins of metascutellum.

Some of the above features (stemmaticum, lack of propodeal spur and shape of sublateral carina) occur in *O. hemipterus* but this is a smaller species with shorter antenna and mps on fl_7 and fl_8 only, and the propodeum is reticulate. Oriental and Palaearctic species that lack a spur are *O. himalayus* Subba Rao, *O. lapen* Triapitsyn, and *O. spartak* Triapitsyn but they differ in other features.

Description. **Female**. Body length 1434–1613 (n=10). Head, flagellum except fl_1 and sometimes fl_2 and fl_3, and mesosoma dark brown; metasoma brown; scape, pedicel, fl_1 and sometimes fl_2 and fl_3, petiole, and legs uniform bright yellow. **Head**. Head (Fig. 34) width 350–407 (n=5). Vertex (Figs. 45, 56) with stemmaticum; mid ocellus diameter 30–36. **Antenna**. Flagellum (Fig. 71) with 2 mps on fl_5–fl_8 and 7 mps on clava. Fl_1 the longest funicle segment. Fl_1–fl_6 length/width ratios (n=5): fl_1 4.19–5.76, fl_2 3.77–4.59, fl_3 3.48–4.54, fl_4 3.18–4.47, fl_5 2.90–3.5, fl_6 2.67–3.35; clava 3.56–3.93× as long as wide, slightly shorter than fl_6–fl_8 together. Measurements (length/width, n=5): scape 260–283/36–44, pedicel 67–71/38–41, fl_1 93–110/19–23, fl_2 88–106/22–23, fl_3 86–108/24–26, fl_4 85–101/23–24, fl_5 90–99/29–31, fl_6 86–97/29–32, fl_7 82–92/30–32, fl_8 77–83/37–42, clava 220–238/57–63. Total flagellum length 907–1032. **Mesosoma**. Pronotum (Figs. 111, 114) with collar narrow, long and clearly visible in dorsal view, with well defined carina (Figs. 111, 114). Mesonotum (Figs. 111, 114) wide; midlobe of mesoscutum with meshes engraved; scutellar seta long, extending well posterior to frenal line; frenum about 0.6× mesoscutellum length and entirely reticulate, frenal line slightly concave medially. Metanotum with metascutellum smooth. Propodeum (Fig. 133) smooth between carinae and its anterior margin without stub; median areole well separated from metascutellum by fairly long median carina not extending to metascutellum; plica uniformly curved, extending to metascutellum medial to its lateral margin, and not divided anteriorly. **Wings**. Fore wing (Fig. 152) length 1529–1763, width 570–650, length/width 2.55–2.68, longest marginal setae 68–91, about 0.13× as long as greatest wing width. Hind wing (Fig. 152) length 1175–1311, width 65–79. **Metasoma**. Petiole shorter than metacoxa + metatrochanter. Gaster (Fig. 167, 175) with ovipositor length 455–505 (n=5), 0.81–0.85× as long as metatibia (554–608).

Male. Body length 1210–1469 (n=10). Entire flagellum dark brown. Antenna (Fig. 84). Measurements, length (n=4): scape 188–202, pedicel 61–65, fl_1 155–174, fl_2 171–198, fl_3 164–198, fl_4 165–195, fl_5 166–192, fl_6 168–188, fl_7 166–186, fl_8 162–177, fl_9 161–170, fl_{10} 153–170, fl_{11} 147–157. Total flagellar length 1184–1994. Each flagellomere slightly bottle-shaped, distinctly wider towards base (Fig. 84). Fl_6 length/width 4.27–5.03, with about 8 mps. Mid ocellus diameter 34. Genitalia fairly narrow in anterior half (Fig. 180).

Hosts and habitat. Hosts are unknown. Specimens have been collected mainly in forests, from old growth rainforest (hemlock and cedar), to deciduous forest (alder and cottonwood) but also from a meadow. *Ooctonus occidentalis* has often been collected at the same times and places as *O. canadensis*.

Barcoding. Two of three specimens yielded barcodes (CNCHYM07504, CNCHYM07507), the third did not (CNCHYM07508). There was no intraspecific variation based on DNA, not surprisingly because the specimens were from the same collecting event. Two other specimens were incorrectly assigned to *O. occidentalis* prior to barcoding. They belong to *O. canadensis*.

Variation. The Alaska specimen has both antennae missing beyond fl_4 (and part of this segment may also be missing) and the propodeal carinae differ slightly from other specimens. It is identified *O. occidentalis* with some doubt.

Material examined. 28♀ and 29♂. **CANADA**. **British Columbia**. Near Elk Falls, 49°08.25′N 121°48.16′W, 500m, 9.viii.2001, D. Gillespie, H. Goulet, L. Hoey, old meadow and old growth rainforest (hemlock and cedar), CNCHYM07508 [barcode failed] (3♀, 3♂, CNC); Manning Provincial Park, 650m, 1-10.vii.1988, S. & J. Peck (1♀, 1♂, CNC); Queen Charlotte Is., Charlotte City, 9.viii.1960, W.R. Richards (1♂, CNC), Graham I., Masset, 9-13.vii.1983, I.M. Smith (1♂, CNC), Graham I., Rennel Sound, 15.vii.1983, I.M. Smith, sweeping grasses and alders (1♂, CNC), Graham I., Tow Hill, 7.vii.1983, I.M. Smith (1♂, CNC); Sooke, 48°23′44.6″N 123°45′55″W, 90m, 27-31.vii.2010, A. Bennett, MT (1♂, CNC); Sumas Mountain Provincial Park, 29.vii.1980, G. Gibson, sweeping (2♀, USNM); Terrace, 2.viii.1960, W.R. Richards (1♂, CNC); Tweedsmuir Provincial Park, Bella Coola Valley, Stuie, 23.vii-4.viii.1983, I.M. Smith, meadow, pitfall trap (1♀, CNC); Vancouver, 10.vii.1988, J.R. Vockeroth (1♂, CNC), Pacific Spirit Provincial Park, 7.viii.1997, I. Klimaszewski, forest edge (1♀, CNC); Vancouver I., Lake Cowichan, 1.7 km N. of town, 24.vii.1979, 19-28.vii.1985, I.M. Smith, at seepage area, sweeping (4♀, 1♂, CNC), Sayward, 1000', 14.vi-10.xi.1984, D. Miller, PT, alder/cottonwood (1♀, 1♂, CNC). **USA**. **Alaska**. 14 km N. Juneau, Mendenhall Valley, Dredge Lake, 17-25.viii.1999, M. Schultz, MT (1♀, 2♂, UCRC); Sitka, 0-100m, vii.1970, N.L.H. Krauss (1♂, USNM); Valdez, Valdez Glacier Campground, 2.viii.1978, P.H. Arnaud (2♀, CAS). **California**. *Del Norte Co.*: Crescent City, 3.viii.1940, H. & M. Townes (2♀, 2♂, AEIC); Klamath, coastal trail, 3.viii.1985, L. Masner, sweeping, CNCHYM07504, CNCHYM07507 (11♀, 11♂, CNC, UCRC). **Oregon**. *Curry Co.*: Port Oxford, 10.vii.1985, I.M. Smith, 4.6 km from 101, stream by road to McGribble Campground (3♀, 2♂, CNC). **Washington**. *Clallam Co.*: Agnew, 25.vii.1990, J.D. Pinto. *Pacific Co.*: 23.2 mi. S. South Bend on US 10, 8-11. ix.1968, D.D. Munroe, MT (1♀, CNC).

Ooctonus quadricarinatus Girault

(Figs. 3, 6, 7, 17, 22, 35, 57, 72, 85, 95, 115, 118, 134, 140, 153, 181, 189, 192, 195–198)

Ooctonus quadricarinatus Girault, 1916b: 301; Girault, 1929: 21 (key); Peck, 1951: 411 (catalogue); Peck, 1963: 19 (catalogue); Burks, 1979: 1027 (catalogue).
Ooctonus quadrisiguatus Blackman, 1915: 56 (nomen nudum).

Type material. Lectotype ♂ (Fig. 17) in USNM (examined), here designated to avoid confusion about the identity of this species, on slide (Fig. 22) labeled: 1. "Ooctonus

quadricarina-tus Gir ♂ types.". 2. "Ooctonus quadricarinatus Lectotype ♂ des. Huber 2011". 3. "19942". 4. "+1♂ Polynema (Doriclytus) Det. J. Huber & S. Triapitsyn 2008". The lectotype is the most intact specimen of *Ooctonus quadricarinatus* (only head separated from rest of body).

Paralectotypes. The two other, broken up males of *O. quadricarinatus* [and two males of *Polynema* (one is a head + antennae only)] under one cover slip on the type slide are designated here as paralectotypes. The types clearly are most of the specimens mentioned by Blackman (1915), probably using a name supplied to him by Girault who then changed his mind about the specific epithet when he described the species a year later. Blackman (1915) incorrectly recorded the sex of the *Ooctonus* specimens as female but astutely noted that the host could not be a species of Scolytidae but possibly came from eggs of tree hoppers or leaf hoppers.

Diagnosis. *Ooctonus quadricarinatus* is distinguished from other Nearctic species by the combination of large size, very dark petiole and coxae (Fig. 3), and ovipositor exserted distinctly beyond the gastral apex.

Description. **Female**. Body length 1382–1843 (n=10). Head and mesosoma black, metasoma dark brown, except petiole apically and gaster basally and ovipositor lighter brown; antenna dark brown except radicle and scape and pedicel laterally usually yellowish; coxae, femora, and apical tarsomere dark brown, trochanters, tibiae, and tarsomeres 1–4 usually yellowish (Fig. 3). Mandibles brown. **Head**. Head width (n=4) 316–352. Vertex without stemmaticum (Fig. 57-male). Mid ocellus diameter 27–35. **Antenna**. Flagellum (Fig. 72) with 1 mps (rarely 0) on fl_5, 1 mps on fl_6, 2 mps (rarely 1) on fl_7, 2 mps on fl_8, and 7 mps on clava; fl_3 slightly the longest funicle segment. Fl_1–fl_6 length/width ratios (n=5): fl_1 4.03–5.00, fl_2 4.29–5.70, fl_3 4.08–4.98, fl_4 3.94–4.61, fl_5 3.58–3.88, fl_6 3.10–3.52; clava 4.01–4.74× as long as wide, and almost as long as half of fl_6 + fl_7 and fl_8 together. Total flagellum 708–758. Measurements (length/width, n=5): scape 230–260/30–44, pedicel 30–44/32–36, fl_1 80–90/18–22, fl_2 93–105/21–25, fl_3 98–107/21–24, fl_4 90–99/20–24, fl_5 93–98/21–27, fl_6 78–91/24–27, fl_7 89–94/30–32, fl_8 76–84/32–42, clava 208–227/44–55. Total flagellum length 905–995. **Mesosoma**. Pronotum (Figs. 115, 118) with collar moderately narrow and short but clearly visible in dorsal view, with well defined carina. Mesonotum (Figs. 6, 7, 95, 115, 118-male) moderately wide; midlobe of mesoscutum with meshes engraved; scutellar setae short, extending posteriorly at most to medially almost straight frenal line; frenum about 0.66× mesoscutellum length. Metanotum with metascutellum smooth. Propodeum (Fig. 134-male) smooth between carinae, and anterior margin of propodeum with a stub slightly lateral to lateral margin of metascutellum; median areole separated from metascutellum by fairly short median carina; plica straight, its anterior apex extending almost to stub, and with a short bifurcation. **Wings**. Fore wing (Fig. 153-male) length 1508–1623, width 528–581, length/width 2.81–2.88, longest marginal setae 63–75, about 0.13× as long as greatest wing width (n=4). Hind wing (Fig. 153-male) length (n=3) 1156–1194, width 69–71, longest marginal setae 94–103. **Metasoma.** Petiole almost as long as metacoxa + metatrochanter. Gaster (Fig. 189) with ovipositor length 1173–1253 (n=5), 1.77–2.17× as long as metatibia (580–683), and distinctly projecting beyond gastral apex.

Male. Body length 1152–1638 (n=10). Antenna (Fig. 85). Measurements, length (n=3): scape 188–199, pedicel 63–69, fl_1 159–164, fl_2 182–194, fl_3 184–200, fl_4 188–190, fl_5 171–195, fl_6 167–187, fl_7 168–185, fl_8 163–176, fl_9 159–166, fl_{10} 166–171, fl_{11} 153–174. Total flagellar length 1887–2027. Fl_6 length/width 3.82–4.73, with 8 or 9 mps. Mid ocellus diameter 39–41. Gaster (Fig. 192). Genitalia fairly wide (dorsal view) for most of its length (Figs. 181, 192).

Hosts and habitat. One male (Ontario, Chalk River) was recorded from *Pissodes strobi* Say (Curculionidae). Additional rearing records are needed to confirm the weevil host. Many specimens have been obtained from stumps, logs or forests of *Pinus* [some infested with *Tomicus piniperda* (L.)], others from meadows or openings in forests and two from grassland and plankton netting. The latter two specimens were evidently collected during dispersal. Blackman (1915) collected the type series from *Pinus strobus* L.

Barcoding. Four of five specimens yielded barcodes (CNCHYM07470, CNCHYM07471, and CNCHYM07472, CNCHYM07473) and one did not (CNCHYM07469). There was slight variation in DNA among the specimens.

Material examined. 34♀ and 74♂. **CANADA**. **New Brunswick**. *Queen's Co.*: 25 km W. Canaan Forks, hwy. 112, 19.viii.1984, M. Kaulbars (1♂, CNC). *Albert Co.*: Fundy National Park, Chignecto campsite, 6-10.viii.2009, J. Fernández, YPT (2♂, CNC). *Kent Co.*, Kouchibouguac National Park, 18.v.1977, G.A.P. Gibson (3♂, CNC). **Nova Scotia**. Bay of Fundy, 21.viii.1979, A. Locke, from plankton sample (1♀, CNC); Kejimkujik National Park, Peter's Point, 44.36571°N 65.19624°W, 2.viii.2009, J. Fernandez, mixed forest, swamp, CNCHYM07469 [barcode failed], CNCHYM07470, CNCHYM07472, CNCHYM07473, (1♀ and 5 ♂, CNC). **Ontario**. Alfred Bog, 29.vii.1984, M. Sanborne (1♂, CNC); 5 mi. E. Camden East, 44°20'19"N 76°47'46"W, 1-8.viii.1997, P. Bouchard, grassland, MT (1♀, CNC); Chalk River, 18.viii.1951, J.M. Anderson, ex *Pissodes strobi* (1♂, CNC); near Clayton, 12.viii.1981, C. Babcock, H. Goulet (3♀ and 2♂, CNC); Constance Bay, 6-23.vii, 12-24.viii, and 26.viii-7.ix.1983, M. Sanborne (1♀and 4♂, CNC); near Flanboro, Lawson Farm, 21-30.ix.1996, alvar, B. DeJonge, MT (1♀, CNC); Guelph, ex trap logs of Scots and Jack pines infested with *Tomicus piniperda*, collected 24.iii-29. vi.1998, em. 21 and 30.vii.1998 in laboratory, K. Ryall (3♀ and 7♂, ROM, CNC) and 20 km S., Reid Property, 23.vii-8.viii.1998, K. Ryall, ex *Pinus sylvestris* log (6♀ and 20♂, CNC); Haliburton Forest and Wildlife Reserve, 45°15'N 78°35'W, 7 and 8.viii.2001, C. Vance, pine forest, MT (2♀, CNC); Hamilton, 14-22.viii.1981, M. Sanborne (1♀, CNC); London, 1-17.ix.1972, A. Tomlin, pine hedgerow (1♂, CNC), Fanshawe Experimental Farm, 10-31. vii, 5.ix.-2.x.1981, 4-25.viii.1982, A. Tomlin (1♀ and 3♂, CNC); Nepean, Bruce Pit, 1-14. xi.1993, and Merivale Gardens, 1-11.xi.1984, L. Masner, YPT (2♀, CNC); Palgrave, SE. Of Orangeville, 1.viii.1998, K. Ryall, ex *Pinus sylvestris* log (2♂, CNC); Rockton, 1.viii.1998, K. Ryall, ex *Pinus sylvestris* log (1♂, CNC); Rondeau Provincial Park, 13.viii.1980, C.M. Yoshimoto (1♀, CNC), near hwy. 16, 44°47'12"N 75°30'38"W, 16-22.viii, 27.ix-5.x.1994, L. Masner, YPT CNCHYM07471 (3♂, CNC); Woodside, 27.viii.2007, ex *Pinus sylvestris* log, P. DeGroot (1♂, CFS-Great Lakes). **Prince Edward Island**. Millvale, 46°25′7″N 63°26′22″W, river, 30.viii.1992, J. Heraty. **Quebec**. Gatineau Park, 26.viii.1987, sweeping,

and vii-viii.1989, L. Masner, emergence trap over pine stump (2♀, CNC), Luskville Falls, 300m, 12-19.viii, 25.viii-2.ix.1986, J. Denis, L. Dumouchel, blueberry fields in oak-conifer clearing, YPT (2♂, CNC), near Luskville Falls, 27.vii-4.viii.1992, CNC Hym team (1♂, CNC). **USA. Alabama**. *Baldwin Co.*: Tensaw, 31.17°N 87.72°W, 15.xii.2004, E. Benton (1♀, CNC). **Arkansas**. *Johnson Co.*: 12 mi. NE. Clarksville White Road Spring, 11.viii-6.ix.1994, G. Leeds, YPT (1♂, CNC). **New York.** *Otsego Co.*: Oneonta, 1900′, 18.viii.1935, H.K. Townes, swamp (1♂, AEIC). **North Carolina**. 14 mi. NW. Highlands, Nantahala National Forest, 3500′, 27.ix.1980, L. Masner and B. Bowen (1♀, CNC). **South Carolina**. *Aiken Co.*: no locality given, 3.viii.1998, J.P. Pitts (1♂, CNC). **Tennessee**. *Blount Co.*: Great Smoky Mountains National Park, Top of the World, 35°38′N 83°55′W, 670m, 2-16.vii.1998, H. Alley, old growth pine, MT (6♂, CNC). *Henderson Co.*: Lexington, Natchez Trace State Park, 11-15.vi.1972, G. Heinrich, MT (1♂, CNC). **Virginia**. *Essex Co.*: 1 mi. SE. Dunnsville, 37°52′N 76°48′W, 14.iii-3.iv, 12-21.vi, 3-20.viii.1996, D.R. Smith, MT (5♀, 2♂, USNM). *Hardy Co.*: 3 mi. NE. Mathias, 38°55′N 78°49′W, 2-16.vii, 17.vii-2.viii, 22.vii-13.ix, and 14.ix-14.x.2002, D.R. Smith, MT (5♀ and 1♂, CNC). *Louisa Co.*: 4 mi. S. Cuckoo, 15.vi.1985, J. Kloke, D.R. Smith, MT (1♀, USNM). *Montgomery Co.*: 8 mi. N. Blacksburg, 1000m, 24.x-8.xi.1987, MT (1♂, CNC); *Page Co.*: Shenandoah National Park, Big Meadow, 1300m, 8.vii-20.viii.1987, CNC Hym. Team, MT (1♂, CNC), Skyline Parkway S., 610-915m, 20.ix.1980, L. Masner and B. Bowen (1♀, CNC).

Ooctonus readae Huber, sp. n.

(Figs. 2, 8, 10, 23, 36, 58, 73, 86, 94, 116, 119, 135, 154, 168, 176, 190)

Type material. Holotype ♀ (CNC), on slide (Fig. 23) labeled: 1. "Canada: ON, Buckham's Bay, 45.4985°N 76.1108°W, 15-20.v.2010, J. Read, MT". 2. "Ooctonus readae Huber Holotype ♀ dorsal".

Paratypes. 43♀ and 20♂. **CANADA**. **Ontario**. Buckham's Bay, 45.4985°N 76.1108°W, 15-20.v CNCHYM07465 [barcode failed], 21-28.v.2010 CNCHYM07466 [barcode failed], J. Read, MT (30♀, 9♂, CNC); 5 km NW. Almonte, hwy 49, Burnt Lands Provincial Park, 45°5.29′N 76°08.39′W, H. Goulet, J. Frenandez, 29.v.2008, alvar, sweep (4♀, 8♂, CNC); North Gower to Smiths Falls, 45°02′N 75°54′W, 14-16, 17-19.v.2004, A. Bennett, D. Barnes, MT (5♀, 1♂, CNC); Ottawa, 45°21.365′N 75°42.426′W, 24-30.v.2007 CNCHYM07464, 1-15.v.2010, H. Goulet, city garden, MT, (4♀, 2♂, CNC)

Derivation of specific epithet. The species is named after Jennifer Read, an excellent technician who has produced outstanding digital images for my publications on Mymaridae.

Diagnosis. *Ooctonus readae* is distinguished from most other Nearctic species by the frenum medially smooth or almost so (with reticulate sculpture much weaker or absent medially than laterally), a feature shared with *O. silvensis* and *O. vulgatus*.

Ooctonus readae differs from *O. vulgatus* by its larger ocelli (smaller in *O. vulgatus*), smaller eye (larger in *O. vulgatus*), longer marginal vein (shorter in *O. vulgatus*), shorter and relatively wider fl_2, and narrower pentagonal areole that does not extend to the metascutellum (wider areole extending to metascutellum in *O. vulgatus*). *Ooctonus readae*

differs from *O. silvensis* by the presence of mps on fl_5 and fl_6 (mps absent on fl_5 and usually on fl_6 in *O. silvensis*).

Description. **Female**. Body length 1024–1178 (n=10). Head and mesosoma dark brown, almost black, petiole brownish yellow, metasoma very dark brown; radicle yellow, scape laterally and ventrally and pedicel apically brownish yellow, flagellum dark brown; legs yellowish, almost always with strong brown suffusion medially on femora and tibiae and sometimes procoxa; apical tarsomere of each leg dark brown (Fig.2). **Head**. Head (Fig. 36) width 295–309 (n=5). Vertex (Fig. 58) without stemmaticum; mid ocellus diameter 21–26; LOL about 2.5. **Antenna**. Flagellum (Fig. 73) with 1 mps on fl_5, usually 1 (sometimes 0) mps on fl_6, and 2 mps on fl_7 and fl_8. Fl_1 and fl_5 equally long, slightly the longest funicle segments. Fl_1–fl_6 length/width ratios (n=5): fl_1 2.32–3.00, fl_2 1.97–2.37, fl_3 1.98–2.27, fl_4 1.85–2.15, fl_5 1.88–2.12, fl_6 1.35–1.68; clava 3.09–3.31× as long as wide, and slightly longer than fl_6–fl_8 together. Measurements (length/width, n=5): scape 189–204/40–43, pedicel 66–71/35–36, fl_1 51–60/19–24, fl_2 47–53/21–24, fl_3 48–55/23–25, fl_4 41–47/21–24, fl_5 51–59/25–30, fl_6 42–48/26–30, fl_7 48–51/31–37, fl_8 46–52/36–39, clava 165–175/50–59. Total flagellum length 539–600. **Mesosoma**. Pronotum (Figs. 116, 119) with collar wide, moderately long and clearly visible in dorsal view, with well defined carina. Mesonotum (Figs. 94, 116, 119) wide; midlobe of mesoscutum with meshes engraved; scutellar setae fairly short, extending slightly posterior to medially almost straight frenal line; frenum 0.60–0.68× mesoscutellum length and smooth or almost so medially, reticulate laterally. Metanotum with metascutellum smooth. Propodeum (Figs. 8, 135) smooth between carinae; anterior margin with stub just lateral to lateral margin of metascutellum; median areole separated from metascutellum by median carina; plica straight or slightly curved outward and not divided anterodorsally, ending just anterior to stub. **Wings**. Fore wing (Figs. 18, 154) length 1137–1194, width 395–412, length/width 2.86–2.97, longest marginal setae 62–71, about 0.17× as long as greatest wing width (n=5). Marginal/stigmal vein 117–134, about 0.5× submarginal vein length. Hind wing (Fig. 154) length 864–921, width 49–62, longest marginal setae 98–107. **Metasoma**. Petiole as long as metacoxa. Gaster (Fig. 168, 176, 190) with ovipositor length 415–509 (n=5), 1.02–1.19× as long as metatibia (397–427).

Male. Body length. 973–1075 (n=10). Antenna (Fig. 86). Measurements, length (n=1): scape 158, pedicel 66, fl_1 103, fl_2 104, fl_3 104, fl_4 102, fl_5 107, fl_6 103, fl_7 104, fl_8 102, fl_9 104, fl_{10} 84, fl_{11} 91. Total flagellar length 1095. Fl_6 length/width 3.67 and with 6(7?) mps. Mid ocellus diameter 25.

Barcoding. One of three specimens yielded barcodes (CNCHYM07464) and two did not (CNCHYM07465 and CNCHYM 07466) even though they were collected into 95% ethanol in a Malaise trap in 2010, so intraspecific variation based on DNA cannot be assessed.

Hosts and habitat. Hosts are unknown. The type series came from a Malaise trap located on a sandy lawn at the edge of a deciduous/coniferous forest.

Ooctonus silvensis Girault

(Figs. 4, 16, 24, 36, 59, 74, 87, 96, 117, 120, 136, 165, 169, 177, 182, 194)

Ooctonus silvensis Girault, 1916a: 70; Girault, 1929: 22 (key); Peck, 1951: 411 (catalogue); Peck, 1963: 19 (catalogue); Burks, 1979: 1027 (catalogue).

Type material. Holotype ♀ in USNM (examined), on slide (Fig. 24) labeled: 1. "Ooctonus silvensis Girault. ♀ type". 2. "19375". The holotype is in poor condition, crushed and broken up (Fig. 16) under one cover slip.

Diagnosis. *Ooctonus silvensis* females are distinguished from most other Nearctic species by the frenum mostly smooth except laterally (Fig. 117), a feature shared with *O. readae* and *O. vulgatus*.

Ooctonus silvensis differs from *O. vulgatus* by its longer marginal vein (shorter in *O. vulgatus*), larger ocelli (ocelli minute in *O. vulgatus*), shorter and relatively wider fl_2 (longer and narrower in *O. vulgatus*), and narrower pentagonal areole that does not extend to the metascutellum (wider areole extending to metascutellum in *O. vulgatus*). *Ooctonus silvensis* differs from *O. readae* by the absence of mps on fl_5 and fl_6 (mps present on fl_5 and usually on fl_6 in *O. readae*).

Description. **Female**. Body length 850–1019 (n=10). Head and mesosoma black (fresh specimens) or very dark brown (faded specimens), petiole brownish yellow, metosoma brown; radicle yellow, scape laterally and ventrally and pedicel apically brownish yellow, flagellum brown; procoxa and tarsomeres 5 brown, meso- and metacoxa and all femora and tibiae yellowish brown but yellowish at apices, trochanters and tarsomeres 1–4 yellow (Fig. 4).

Head. Head (Fig. 37) width 251–270 (n=5). Vertex (Fig. 59) without stemmaticum; mid ocellus diameter 24, LOL about 2.0 greatest diameter of ocellus.

Antenna. Flagellum (Fig. 74) with 2 mps on fl_7 and fl_8, and 7 mps on clava. Fl_1 slightly the longest funicle segment. Fl_1–fl_6 length/width ratios (n=5): fl_1 2.33–3.30, fl_2 1.70–2.24, fl_3 1.60–2.04, fl_4 1.55–2.02, fl_5 1.42–1.82, fl_6 1.39–1.51; clava 2.68–3.34× as long as wide, and slightly shorter than fl_5–fl_8 together. Measurements (length/width): scape 169–182/34–38, pedicel 59–61/31–35, fl_1 49–51/16–20, fl_2 35–40/17–21, fl_3 37–42/20–23, fl_4 35–39/21–23, fl_5 40–42/23–24, fl_6 36–38/24–26, fl_7 48–51/29–34, fl_8 44–48/32–40, clava 158–173/51–59. Total flagellum length 482–524. **Mesosoma**. Pronotum (Figs. 117, 120) with collar moderately wide and short but clearly visible in dorsal view, with well defined carina. Mesonotum (Figs. 96, 117, 120) very wide; midlobe of mesoscutum with meshes engraved; scutellar setae short, extending at most to slightly posterior to medially almost straight frenal line; frenum about 0.7× mesoscutellum length and smooth medially, reticulate laterally. Metanotum with metascutellum smooth. Propodeum (Fig. 136) smooth between carinae; anterior margin with stub just lateral to lateral margin of metascutellum; median areole separated from metascutellum by median carina; plica straight and not divided anterodorsally, ending just anterior and medial to stub.

Wings. Fore wing (Fig. 155, 156) length 1010–1088, width 318–363 (n=5), length/width 3.00–3.25, longest marginal setae 76–92, about 0.24 as long as greatest wing width (n=5).

Marginal/stigmal vein 118–131, at least 0.51× submarginal vein length. Hind wing length 795–816, width 42–52, longest marginal setae 76–98. **Metasoma**. Petiole shorter than metacoxa + metatrochanter. Gaster (Fig. 169, 177) with ovipositor 311–367 long (n=5), 1.03–1.08× metatibia length (323–359).

Male. Body length. 840–1126 (n=10). Antenna (Fig. 87). Measurements, length (n=4): scape 141–146, pedicel 60–63, fl_1 75–89, fl_2 72–96, fl_3 76–95, fl_4 79–95, fl_5 80–93, fl_6 79–94, fl_7 82–98, fl_8 82–95, fl_9 88–99, fl_{10} 87–108, fl_{11} 90–100. Total flagellar length 1049–1067. Fl_6 length/width 3.0–3.2, with 7 (8?) mps. Mid ocellus diameter 21. Genitalia very wide for its entire length (Fig. 182, 194).

Hosts and habitat. Hosts are unknown. *Ooctonus silvensis* has been collected mainly in forested areas but also open field or 'prairie' type areas. Label data include mesic hardwood forest, pine/oak savannah, hardwood forest/beaver swamp, meadow, upland deciduous forest/field ecotone, 'prairie', hardwood forest and swamp.

Barcoding. Three of the ten specimens I identified as *O. silvensis* or near *O. silvensis* based on morphology yielded a barcode (CNCHYM07491, CNCHYM07496, CNCHYM 07498) and seven did not (CNCHYM07489, CNCHYM07490, CNCHYM07492, CNCHYM07493, CNCHYM07494, CNCHYM07495 and CNCHYM07497). There was very little variation between two barcodes (one from Florida and one from Missouri). The specimen from Guelph with an almost complete barcode (Fig. 200: 09BBHYM-696) is intermediate between the Florida and Missouri ones. On this basis I consider that all three specimens belong to *O. silvensis*.

Material examined. 126♀ and 46♂. **CANADA**. **Ontario**. 2 mi. SE. Innisville, 45°3′N 76°15′E, 12-19, 19-26.vi.1991, L. Masner, J. Denis, MT and YPT (2♀, CNC); St. Lawrence Islands National Park, Grenadier Island, Centre, 11.vi.1975, E. Sigler (1♀, CNC), 16.vi.1975, R.J. McMillan, CNCHYM07490 [barcode failed] (1♀, CNC), 27.vi.1979, G. Gibson (1♀, CNC). **Quebec**. Mont Pinnacle near Frelighsburg, 20.vi.1991, M. Sharkey (1♀, CNC); Parc de la Gatineau, 2 km W. chemin Pilon, 8-14.vii.1992, and 2 km E. chemin Pilon, 26.v-2.vi.1992, CNC Hymenoptera Team, CNCHYM07489 [barcode failed] (2♀, CNC). **USA**. **Colorado**. 1563, C.F. Baker [no other data] (1♀, 1♂, USNM). **Florida**. *Alachua Co.*: Gainesville, AEI, 3-12.x.1986, J. Allen (1♂, CNC), 20-27.xi.1986, 18-25. iv, 25.vi-3.vii.1987 CNCHYM07492 [barcode failed], 20.xi.87-20.ii.1988, D.B. Wahl, FIT, (10♀, 2♂, CNC), 1-7.xii CNCHYM07491, 21-31.xii.1986, 1-11.i, 12-20.i, 20-30.i, 15-22. ii, 1-15.iii, 18-22.iii, 23-31.1987 W.R.M. Mason (16♀, 3♂, CNC), 12-20.i.1987, L. Masner, mesic hardwood forest, MT (3♀, 1♂, CNC), vi-vii, 3-17.vii.1987, CNC Hymenoptera Team (2♀, CNC). *Wakulla Co.*: Apalachicola National Forest, 30°19.751′N 84°30.309′W, 13-20.vi.2005, F. Ronquist, pine/oak savannah, MT (1♀, UCRC), hwy 65, post office bay, 30°03.565′N 84°59.057′W, 12-20.v.2005, S. Joshi, A. Deans, D. Murray, MT (1♂, UCRC). **Georgia**. *Clarke Co.*: Athens, 25-30.iv.1987, beaver swamp (1♂, CNC), 1.x-23.xi.1987, hardwood forest, beaver swamp (1♂, CNC). *Union Co.*: Cooper's Creek, WMA, 655m, 34°45′56″N 84°05′46″W, 15.v.2002, D. Yanega (1♂, UCRC). **Illinois**. *Union Co.*: Shawnee National Forest, ca. 2 and 15 mi. S Murphysborough, roadside of route 127, 14.iv.2004, R. Rakitov, meadow, vacuum (2♀, 1♂, UCRC). **Maryland**. *Calvert Co.*: Port Republic, viii-

ix.1986, M. Sharkey, MT (4♀, CNC); 4 mi. S. Prince Frederik, 16.iv-7.v.1987, L. Masner, MT (3♀, 1♂, CNC), 7 km S. Prince Frederick, 24.ix-14.xi.1987, CNC Hymenoptera Team, hardwood forest, MT, CNCHYM07493 [barcode failed] (1♀, CNC). *Prince George's Co.*: Patuxent Research Station, 6-20.x.1980, M.E. Schauff, upland deciduous forest/open field ecotone, MT (11♀, 1♂, USNM). **Mississippi**. *Bolivar Co.*: 19 km W. Boyle on hwy 446, Dahomey Wildlife Reserve, 33°42′N 90°56′W, 8-24.vii.1997, N.M. Schiff, MT (1♀, CNC). **Missouri**. *Wayne Co.*: Williamsville, 21.x-11.xi.1987 CNCHYM07498, iii.1988, 1.xi-10.xii.1988, J.T. Becker, MT (17♀, 1♂, CNC). **Ohio**. *Franklin Co.*: Columbus, Kinnear Road "prairie", 1-16.ix, 2-10.x.2003, N.F. Johnson, MT (1♀, CNC). **Oklahoma**. *Latimer Co.*: Red Oak environs, xi.1994, K. Stephan, FIT, CNCHYM07496 (6♀, 2♂, CNC). **Texas**. *Kerr Co.*: Kerrville State Recreation Area, 1800′, 1.vii.1982, G. Gibson (1♂, CNC). *Brazos Co.*: Lick Creek Park, 25.v.1989, G. Zolnerowich (1♂, CNC). *Bastrop Co.*: Bastrop State Park, 24-27.v.1983, M. Kaulbars (1♀, 1♂, CNC). *Robertson Co.*: 8 mi. E. Hearne, 1-21.iv.1991, M. Hallmark, MT (1♀, CNC). *San Patricio Co.*: Welder Wildlife Foundation Refuge, 4.xii.1999, hackberry forest and swamp, L. Masner, sweeping, CNCHYM07497 [barcode failed] (3♀, 4♂, CNC), 28°6′42″N 97°24′24″W, 1.ii-1.iii.2004, S. Peck, MT (4♀, 4♂, UCRC). **Virginia**. *Fairfax Co.*: near Annandale, 6-12.v, 20-26.v.1990, D.R. Smith, MT (2♀, USNM). *Hardy Co.*: 3 mi. NE. Matthias, 38°55′N 78°49′W, 17.iv-3.v.2002, D.R. Smith, MT (1♀, CNC). *Louisa Co.*: 4 mi. S. Cuckoo, 13-27.v.1987, 29.iii-11.iv, 27.v-7.vi, 8-18.vi.1988, J. Kloke, D.R. Smith (9♀, 4♂, USNM). *Montgomery Co.*: 8 km NW. Blacksburg, 1000m, 18-28.iv, 8.iv-9.v, 9-19.v, 29.v-9.vi CNCHYM07494 and CNCHYM07495 [both barcodes failed], 9-19.vi, 19-30.vi, 29.ix-12.x, 8-25.ix, 12-24.x, 24.x-8.xi.1987, CNC Hymenoptera Team, rural area, MT (19♀, 13♂, CNC).

Ooctonus triapitsyni Huber, sp. n.

(Figs. 25, 38, 60, 75, 121, 123, 137, 157, 170)

Type material. Holotype ♀ (CNC), on slide (Fig. 25) labelled 1. "Canada: AB, Writing-on-Stone, Prov. Park 13-18.vii.1990, D. McCorquodale, sage south". 2. "Ooctonus triapitsyni Huber Holotype ♀ dorsal".

Paratypes. 36♀ and 16♂. **CANADA**. **Alberta**. Lethbridge, Agriculture Canada Research Station, 9-15.vii.1980, G. Gibson, PT (1♀, 6♂, CNC); 16 mi. S. McGrath, McIntyre Ranch, 27.vii-2.viii, 26.viii-9.ix.1990, D. Griffith, PT (8♀, 3♂, CNC); Tolman Bridge Recreation Area, 17 km E. Trochu on hwy 585 near Red Deer River, 16-18.vii.1989, J. O'Hara (1♀, 1♂, CNC); Writing-on-Stone Provincial Park, 20-30.vii.1981, D. McCorquodale, PT (1♀, CNC); 5 mi. W. Writing-on-Stone Provincial Park, Milk River Valley, 15.vii.1980, G. Gibson, sweeping (1♀, CNC); 0.5 km E. Writing-on-Stone Provincial Park, 5-13.vii, 30.viii-ix.1981, D. McCorquodale, PT (2♀, CNC). **Ontario**. 3.5 km E. Almonte, 25-29.v.1993, F.W. Grimm, MT & PT, alvar, F.W. Grimm (3♀, 1♂, CNC). **Quebec**. Gatineau Park, Luskville Falls, top, 11.ix.1985, H. Goulet (2♀, 1♂, CNC); Luskville Falls, 300m, 8-15.vii.1986, J. Denis, L. Dumouchel (2♀, CNC). **Saskatchewan**. Saskatoon Landing, 23.vi.1956, O. Peck (1♀, CNC). **USA**. **Alaska**. Fairbanks, Badger road near North Pole, 18.vii.1985, H. Andersen (2♀, UCRC), University of Alaska campus, 19.vii.1985, H. Andersen, CNCHYM07523 [barcode failed] (3♀, 1♂, CNC). **Arizona**.

Cochise Co.: Huachucha Mts., Ash Canyon road, 0.5 mi. W. hwy 92, 5100′, viii and 1-11. xi.1993, N. McFarland, MT, CNCHYM07512 [barcode failed], CNCHYM07513 (6♀, 2♂, UCRC); 12 mi. S. Sierra Vista, Ramsey Canyon, 1700m, 6-13.vii, 4-22.ix.1986, B.V. Brown, MT, oak/juniper (2♀, CNC). *Santa Cruz Co.*: Sycamore Canyon, Harkt and Yank Spring, 4200′, 7-8.vii.1982, G. Gibson, CNCHYM07409 [barcode failed] (1♂, CNC). **South Dakota**. *Charles Mix Co.*: Pickstown, 26.vii.1985, J.D. Pinto (1♀, 1♂, CNC).

Derivation of specific epithet. The species is named after Serguei Triapitsyn, entomology collection manager, University of California, Riverside, a good colleague who has published many papers on Mymaridae.

Diagnosis. *Ooctonus triapitsyni* is distinguished from other Nearctic species by the combination of 2 mps on fl_5–fl_8, (sometimes only 1 mps on fl_6), uniform yellow leg colour, ovipositor longer than metatibia length, and body length greater than about 1075.

Ooctonus triapitsyni is most similar to *O. readae* and *O. notatus* but differs from the former by the uniform yellow legs (brownish in *O. readae*) and presence of one or two mps on fl_6 (none in *O. notatus*). An occasional specimen appears to lack mps on fl_6, as in *O. notatus*, but *O. triapitsyni* has a longer body (at least 1075) compared to *O. notatus* (at most 1000).

Description. **Female**. Body length 1075–1331 (n=10). Head and mesosoma very dark brown, metasoma brown; fl_1–fl_3 light brown to brown, remainder of flagellum dark brown; petiole, legs except apical tarsomere, scape and pedicel uniform yellow.

Head. Head (Fig. 38) width (n=10) 305–352. Vertex (Fig. 60) without stemmaticum. Mid ocellus diameter 19–24.

Antenna. Flagellum (Fig. 75) with 2 mps on fl_5, fl_7 and fl_8, and 7 mps on clava, fl_6 with 1 mps but occasionally (3 of 7 specimens measured) 1 and 2 mps on the same individual, and exceptionally (1 of 10 specimens measured) with 2 mps on each antenna. Fl_5 slightly longer than the remaining funicle segments. Fl_1–fl_6 length/width ratios (n=5): fl_1 2.58–3.09, fl_2 2.38–2.89, fl_3 2.13–2.75, fl_4 1.72–2.19, fl_5 1.58–2.07, fl_6 1.45–1.81; clava 3.34–4.29× as long as wide, and slightly shorter than fl_4–fl_8 together. Measurements (length/width, n=10): scape 210–249/34–44, pedicel 62–75/32–41, fl_1 57–64/20–23, fl_2 52–62/21–26, fl_3 55–65/24–29, fl_4 42–63/24–30, fl_5 56–70/32–36, fl_6 48–63/31–37, fl_7 54–70/35–39, fl_8 51–63/38–42, clava 200–236/53–56. Total flagellum length 615–756. **Mesosoma**. Pronotum (Figs. 121, 123) with collar moderately narrow and short but clearly visible in dorsal view, with well defined carina. Mesonotum (Figs. 121, 123) wide; midlobe of mesoscutum with meshes raised; scutellar seta short, extending just posterior to medially straight frenal line; frenum about 0.66× mesoscutellum length and entirely reticulate. Metanotum with metascutellum smooth. Propodeum (Fig. 137) smooth between carinae and its anterior margin with a stub; median areole separated from metascutellum by a very short to slightly longer median carina; plica straight, with a very short bifurcation anteriorly (median arm slightly longer than lateral arm), extending to apex of stub almost in line with or just lateral to lateral margin of metascutellum. **Wings**. Fore wing (Figs. 155, 156) length 1097–1313, width 352–436, length/width 2.82–3.24, longest marginal setae 25–50, about 0.06–0.13× as long as greatest wing width (n=10). Marginal vein length 124–149. Hind wing (Figs. 155, 156) length

870–985, width 49–54, longest marginal setae 95–108. **Metasoma**. Petiole shorter than metacoxa + metatrochantellus. Gaster (Fig. 170) with ovipositor length 548–634 (n=10), 1.16–1.40× as long as metatibia (408–479).

Male. Body length 998–1254 (n=5). Legs slightly darker yellow than in female, scape and pedicel with brown especially dorsally, flagellum uniformly brown. Antennal measurements, length (n=3): scape 188–192, pedicel 59–65, fl_1 104–111, fl_2 107–127, fl_3 109–131, fl_4 110–128, fl_5 112–127, fl_6 109–125, fl_7 107–125, fl_8 106–117, fl_9 107–117, fl_{10} 106–113, fl_{11} 110–117. Total flagellar length 1160–1329. Fl_6 length/width 3.06–4.12 and with 7 or 8 mps. Mid ocellus diameter 26–29.

Barcoding. One of the specimens (CNCHYM 07513) yielded barcodes so nothing can be said about intraspecific variation based on DNA. The specimen is treated as unassigned in Table 2; it may actually belong to *O. arizonensis*.

Hosts and habitat. Hosts are unknown. Specimens were collected in the boreal forest, and in prairie (G. Gibson, personal communication).

Ooctonus vulgatus Haliday

(Figs. 5, 39, 61, 76, 88, 122, 124, 138, 158, 171, 185, 186)

Ooctonus vulgatus Haliday, 1833: 344; lectotype ♀ in NMID (not examined), designated by Hincks, 1952: 157. Type locality: likely England or Ireland. Synonyms and their types treated by Triapitsyn (2010).

Ooctonus vulgatus Haliday: Foerster, 1847: 197, 200 (mouthparts, description); Ratzeburg, 1848: Plate 3, Fig. 27 (fore wing, male antenna); Schmiedeknecht, 1909: 490 (catalogue); Kloet and Hincks, 1945: 305 (checklist, Britain); Kryger, 1950: 78 (list); Bouček and Graham, 1978: 109 (checklist, Great Britain); Trjapitzin, 1978: 524 (taxonomy, European distribution); Viggiani and Jesu, 1988: 1023 (doubtful host record); Kalina,1989: 127 (checklist, Czechoslovakia); Hansson, 1991: 49 (Sweden checklist); Triapitsyn 2010: 54 (redescription, literature, synonyms, misidentifications), 56 (records from Canada and USA); Huber et al. 2010: 231 (New Zealand records).

Ooctonus americanus Girault 1916a: 69; Girault, A.A. 1929: 21 (key); Whittaker, 1931: 192 (key); Peck, 1951: 410 (catalogue); Weaver and King, 1954: 17 (host, parasitism rate); Burks, 1958: 62 (reference correction); Peck, 1963: 18 (catalogue); Burks, 1967: 213 (catalogue, host); Burks, 1979: 1027 (catalogue, host); Triapitsyn 2010: 54 (synonymy).

Ooctonus askhamensis Hincks, 1952: 156; Kalina, 1989: 127 (checklist, Czechoslovakia).

Ooctonus auripes Whittaker, 1931: 190; Peck, 1951: 410 (catalogue); Burks, 1979: 1027 (catalogue); Triapitsyn, 2010: 28 (synonymy under *notatus*). **Syn. nov.**

Ooctonus sp.: Triapitsyn 2010: 54 (species identification, New Zealand records); Huber et al., 2010: 231 (New Zealand records).

Type material. *Ooctonus americanus*. Holotype ♀ in USNM (examined), on slide labeled: 1. "Ooctonus americanus. Girault ♀ type.". 2. [red label] "19353.". The holotype is

in poor condition, crushed and partly broken up (Fig. 16) together with a specimen of *Gonatocerus* (*Lymaenon*) under one cracked cover slip.

Ooctonus auripes. Lectotype ♀ (BMNH, examined), here designated to avoid ambiguity about the status of the type specimens of this species, on card labelled 1. "Lectotype [purple edged circle]". 2. "Type [red rectangular label]". 3. "Chilliwack, B.C. 15.X.26 Coll. O.W.". 4. "Canada: O. Whittaker Coll. per W.H. Storey. B.M. 1947 - 212.". 5. "Ooctonus auripes Whitt. ♀ Det. O. Whittaker". 6. "B.M. Type Hym. 5.2319". Type mounted (Fig. 11) on card with wings, legs, and antennae (in dorsal view) spread out but metasoma missing.

Triapitsyn (2010: 28) synonymized *O. auripes* under *O. notatus*, based on examination of the paralectotype. The lectotype (Fig. 11) is a different species that matches *O. vulgatus*. *Ooctonus auripes* is therefore placed here in synonymy under *O. vulgatus* instead.

Diagnosis. *Ooctonus vulgatus* is distinguished from other *Ooctonus* species by the single row of bullae inside the female clava (Fig. 76). Otherwise, it is similar to *O. notatus*, *O. silvensis*, and *O. readae* in size but differs by antennal proportions, mps distribution, ocelli size, frenum sculpture, marginal vein length, and propodeal carinae pattern.

Description. Female. Body length 691–1075 (n=10). Head and mesosoma almost black (fresh specimens) or very dark brown (faded specimens), petiole brownish yellow, metasoma dark to light (almost yellowish) brown; radicle yellow, scape laterally and ventrally and pedicel apically brownish yellow, flagellum brown; legs almost entirely brown to entirely yellow except apical tarsomere of each leg. **Head**. Head width 245–290 (n=5). Vertex without stemmaticum; mid ocellus minute, diameter about 16. LOL at least 4× greatest diameter of mid ocellus. **Antenna**. Flagellum (Fig. 76) with 2 mps on fl_7 and on fl_8, and 7 mps on clava. Fl_1 slightly the longest funicle segment. Fl_1–fl_6 length/width ratios (n=5): fl_1 3.05–4.42, fl_2 2.69–4.08, fl_3 1.85–2.69, fl_4 1.51–2.22, fl_5 1.37–1.80, fl_6 1.35–1.64; clava 2.6–3.5× as long as wide, and about as long as fl_6–fl_8 together, with a single row of about 6 abutting spherical bullae internally along ventral margin. Measurements (length/width, n=5): scape 161–186/23–30, pedicel 51–61/29–33, fl_1 50–59/12–17, fl_2 45–58/14–17, fl_3 41–53/18–23, fl_4 30–37/16–20, fl_5 30–36/18–23, fl_6 29–36/21–23, fl_7 42–50/25–30, fl_8 41–45/28–30, clava 114–132/36–46. Total flagellum length 422–506. **Mesosoma**. Pronotum (Figs. 122, 124) with collar moderately wide and short but clearly visible in dorsal view, with well defined carina. Mesonotum (Figs. 122, 124) very wide; midlobe of mesoscutum with meshes raised; scutellar seta short, extending at most slightly posterior to medially almost straight frenal line; frenum about 0.7× mesoscutellum length and apparently smooth medially (at most very faintly reticulate), reticulate laterally. Metanotum with metascutellum smooth. Propodeum (Fig. 138) smooth between carinae; anterior margin with stub slightly lateral to lateral margin of metascutellum; median areole abutting metascutellum, the median carina absent and replaced by the two carinae forming inner margin of dorsolateral areoles; plica almost straight and not divided anterodorsally, ending just anterior and medial to stub. **Wings**. Fore wing (Fig. 158) length 862–1049, width 266–375 (n=5), length/width 2.69–3.26, longest marginal setae 49–77, about 0.19× as long as greatest wing width. Marginal /stigmal vein

80–94, at most 0.48 submarginal length. Hind wing length 668–802, width 35–49, longest marginal setae about 2.26× greatest wing width. **Metasoma**. Petiole shorter than metacoxa. Gaster (Fig. 171) with ovipositor 368–464 long (n=5), 1.14–1.27× as long as metatibia (357–403).

Male. Body length. 794–1152 (n=3). Antenna (Fig. 88). Measurements, length (n=3): scape 153–159, pedicel 58–63, fl_1 69–72, fl_2 87–103, fl_3 87–103, fl_4 79–94, fl_5 82–106, fl_6 85–103, fl_7 86–99, fl_8 86–94, fl_9 90–93, fl_{10} 85–88, fl_{11} 86–87. Total flagellar length 918–1050. Fl_6 length/width 3.50–4.40, with 5(6?) mps. Mid ocellus diameter 24. Genitalia fairly wide for most of its length (Fig. 185, 186).

Barcoding. Four of the five specimens yielded barcodes (CNCHYM07484, CNCHYM07485, CNCHYM07487, and CNCHYM07488) and one did not (CNCHYM07486). The variation among the specimens was not uniform and the sequences were of low or medium quality except for CNCHYM07485. The two specimens from Virginia varied more between them than each did to the single specimens from Ontario and British Columbia.

Hosts and habitat. The only known host is *Philaenus spumarius* (L.) [= *P. leucophthalmus* (L.)] (Cercopoidea). Weaver and King (1954) collected 304 host eggs in 1951 and obtained 21 individuals of *O. vulgatus* (named as *O. americanus)*, a parasitism rate of 6.9%. In 1952 they collected 1084 eggs, 10.7% of which showed evidence of parasitism but parasitoids did not emerge from all these. The authors concluded that 10% parasitism rate is therefore too high an estimate. Specimens have been collected in a weedy garden, urban lot, mixed grass prairie, rocky knoll with intact *Manzanita/Arbutus,* hardwood/deciduous forest, sugar bush [maple forest], old field, ocean side vegetation, ex soil. Presumably, *O. vulgatus* occurs wherever its host occurs. It has been intercepted on thyme cuttings from France.

Distribution. Palaearctic Region (Triapitsyn 2010), New Zealand (Triapitsyn 2010, Huber 2010, as an unintentional introduction), Nearctic Region (Triapitsyn 2010, and additional records below).

Material examined. 323♀ and 7♂. **CANADA**. **Alberta**. 0.5 km E Writing-on-Stone Provincial Park, 8-17.ix.1981, D. McCorquodale (1♀, CNC). **British Columbia**. Burnaby, Simon Frazer University, 26.xii.1979-2.i.1980, D. Gillespie, PT (5♀, CNC); Burnaby Mountain, 6.x-12.xi.1979, 7-21.iii, 21.iii-3.iv.1980, D. Gillespie, YPT (24♀, CNC); Queen Charlotte Islands, Graham I., Masset, 9-13.vii.1983, I.M.Smith (1♀, CNC); Shushwap Lake, Blind Bay, 15-31.viii.1986, 11-21.vii.1987, C.A. Elsey, MT (2♀, CNC); Sorrento, 17-20.vii.1991, H. Goulet, weedy garden, YPT (1♀, CNC); Upper Carmanah Valley, 12-27.viii, 28.viii-9.ix, 10-29.ix, 17-26.x.1991, N. Winchester, MT (8♀, 3♂, CFS-Victoria); Victoria vicinity, 48°32′N 123°30′W, 248m, 4-18.ix.2005, N. Winchester, rocky knoll, intact *Manzanita/Arbutus*, CNCHYM07485 (3♀, CNC). **Nova Scotia**. Bridgetown, 26.vii, 8.viii, 16.viii, 4.ix, 16.ix, 23.ix, 1.x.1913, G.E. Saunders (12♀, USNM). **Ontario**. Alfred Bog, 13.vii.1981, L. LeSage (1♀, CNC); Ancaster, 4-11.vi.1994, B. DeJonge, prairie remnant, CNCHYM07484 (1♀, CNC); near Ancaster, 43°15′N 80°00′W, 29.ix-27.v.1995, B. DeJonge, bush/prairie, MT (1♀, CNC), Newton Woods, 20-31.v.1996, B. DeJonge, forest, MT (1♀, CNC); 15 km SW. Chaffey's Locks, 28.v.1987, C. Yoshimoto, C. Hayward, sweeping,

CNCHYM07486 [barcode failed] (4♀, CNC); Chatham, emerged xii.1956 ex *Philaenus leucophthalmus*, H.B. Wressell, G.R. Driscoll (7♀ on 2 slides, CNC); Chatterton, 13 mi. N. Belleville, 20 and 30.v.1962, 1.x.1970, C.D. Dondale, meadow (3♀, CNC); Guelph, University of Guelph arboretum, 43° 32′N 80° 13′W, 14.v, 12-32.v, 24-31.v, 5.vi, 2006, L. Coote (9♀, UCRC); Hamilton, 15.v.1981, M. Sanborne, MT (2♀, CNC); Joker's Hill (near Newmarket), hwy 9 between Dufferin & Bathhurst Streets, 1-9.vi.2002, A. Bennett, sugar bush, MT (1♀, CNC); London, Fanshawe Experimental Farm, 5.ix-2.x.1981, 5.xi.1982, A. Tomlin (2♀, 1♂, CNC); Middleville, White Lake road, 13.v.1986, H. Goulet, S. Peck, car net (1♀, CNC); Milton, 2.vi.1978, J.M. Heraty, YPT (1♀, CNC); Point Pelee National Park, 3.x.1984, A. Borkent (1♀, CNC). **USA**. **Arkansas**. *Montgomery Co.*: Ouachita National Forest, 270m, 34° 33′N 94°37′W, 3-4.vi.2003, R. Kula, M. Yoder (1♀, UCRC). **California**. *Marin Co.*: Lily Pond, Alpine Lake, 1500', D.D. Munroe, 4-10.v.1971 (1♀, 1♂, CNC). *San Bernardino Co.*: 5 mi. E. Wrightwood, Summit Valley, 21.v.1981, M.E. Schauff, sweeping (1♀, USNM). *Stanislaus Co.*: Oakdale, 37°46′57″N 120°46′59″W, 30.iv.2007, rural yard, R. Shurtz, S. Fullerton (2♀, UCFC). **Kansas**. *Riley Co.*: Konza Prairie Biological Station, Watershed 2C, 39°04.254′N 96°33.639′W, 26.vi-3.vii.2006, G. Zolnerowich, Metlevski, MT (1♀, USNM). **Maryland**. *Calvert Co.*: American Chestnut Land Trust, Warrior's Rest Sanctuary, 38°31′54.37″N 76°32′35.71″W, 14.ix.2007, M. Gates, R. Kula (1♀, USNM); Port Republic, viii-ix.1986, M. Sharkey, MT (1♀, CNC); 4 mi. S. Prince Frederick, 16.iv-7.v, 24.ix-14.xi.1987, L. Masner, hardwood forest, MT, FIT (12♀, CNC). *Howard Co.*: Clarksville, 8.xi.1986, A. Denno, E. Grissell, MT (1♀, USNM). *Montgomery Co.*: 4 mi. SW. Ashton, 5.v.1985, G.F. and J.F. Hevel (1♀, USNM), Silver Springs, 11-2.vii.1980, E.E. Grissell (1♀, UCRC). *Prince George's Co.*: Beltsville Agriculture Research Center, 18.viii.1983, M.E. Schauff, sweeping old field (1♀, USNM); Laurel, Patuxent Wildlife Research Center, 16-25.v, 25.v-1.vi.1979, M.E. Schauff (3♀, USNM). **New Jersey**. *Sussex Co.*: 17.i.1962, L.D. Parker, ex meadow spittlebug (5♀ on one slide, USNM). **New York**. *Tompkins Co.*: McLean, McClean Bog, 736′, 42°32.687′N 76°15.995′W, 26.v.2007, E.F. Drake, YPT on leaf duff (1♀, UCRC). **Ohio**. *Cuyahoga Co.*: Cleveland, urban lot, 41°27′49.84″N 81°36′43.14″W, K. Freeman, YPT (1♀, CLEV); Hunting Valley, Luce Creek Preserve, 15-26.v.2003, T. Pucci (1♀, CLEV). *Fairfield Co.*: Barnebey Center, 39°36′N 82°37′W, 28.iv-6.v.1993, N. Johnson, MT (6♀, CNC). *Warren Co.*: 4.2 km SSE Donaldson, Rock Run, 540m, 41°37′41″N 78°59′11″W, 12.v.1994, M. Ricke (1♀, ICCM). *Wayne Co.*: Wooster, 28.iv.1952, ex meadow spittlebug, C.R. Weaver (5♀ on one slide, USNM); same locality, [no month] 1951, ex spittlebug eggs, R.C. Weaver (2♀, on one slide USNM), [no specific locality], x.1950, ex spittlebug egg, C.R. Weaver (1♀ on point, USNM). **Oregon**. *Baker Co.*: 18.vii.1981, R.E. Orth (1♀, CNC). *Jackson Co.*: 10.5 mi. E. Ashland, road to Howard Prairie Lake, 42.2404°N 122.5263°W, 4.v.2005, R. Rakitov, vacuum (1♀, UCRC). *Lincoln Co.*: 2 mi. S. Newport, South Beach State Park, 23.viii.1984, M.E. Schauff, P. Hanson, sweeping ocean side vegetation (5♀, USNM). **Pennsylvania**. *Cambia Co.*: 3 km N. Wilmore, 650m, 30.v.1991, L. Masner, sweeping (1♀, CNC). *Dauphin Co.*: Harrisburg, 2301 Cameron Street, emerged from soil under Andorra juniper, soil collected 21.ii, adult emerged 28.ii.1975, J. Steinhauer (1♀, USNM). *Warren Co.*: Weldbank, 41°45.749′N 79°5.752′W, 29.v.2007, E.F. Drake, YPT (1♀, UCRC). **Virginia**. *Clarke Co.*: 2 mi. S. Boyce, University of Virginia, Blandy Experimental Farm, 19-30.iv, 6-18.iv, 24-30.iv, 1-13.v, 14-24.v, 28.viii-11.ix.1990, D.R. Smith, MT (62♀, 1♂, USNM). *Fairfax Co.*: near Annandale,

4.iv.1986, 22-28.iv, 24-30.iv.1988, 29.iv-5.v, 6-12.v, 1-13.v, 13-19.v, 27.v-2.vi, 26.viii-1.ix.1990 (39♀, USNM); Turkey Run Park, 38°57.9′N 77°09.4′W, 29.iv.2010, J. Huber, H. Goulet, deciduous forest, sweeping (2♀, 1♂, CNC). *Hardy Co.*: 3 mi. NE. Mathias, 38°55′N 78°49′W, 15-30.v.2001, 17.iv-3.v.2002, D.R. Smith, MT, CNCHYM07487 (8♀, CNC); *Montgomery Co.*: 8 km NW. Blacksburg, 1000m, 8.iv-9.v, 18-28.iv, 9-19.v.1987, rural area, CNC Hymenoptera team, MT (25♀, CNC); *Page Co.*: Shenandoah National Park, Big Meadow, 18-28.iv, 17.iv-5.v, 5-22.v, 5.v-5.vi.1987, 1300m, CNC Hymenoptera team, CNCHYM07488 (24♀, CNC), Compton Dry Run, 15-16.iv.1995, L. Masner, YPT (1♀, CNC), Compton Gap, 800m, 17.iv-5.v.1987, CNC Hymenoptera team, MT (8♀, CNC). **Washington**. *Pacific Co.*: 6 mi. N. Raymond, 19.vii.1988, J.D. Pinto (1♂, CNC).
FRANCE. Intercepted on thyme cuttings, New York port of entry, 19.x.1951, L.J. Uttal, (1♀, USNM) [det. as *O. heterotomus* by B.D.Burks [= *O. notatus*] and *O.* ?*vulgatus* by S.V. Triapitsyn].

Unassigned specimens. About 90 additional specimens, mostly males but also a few females, either cannot be identified or may represent additional species. If the females represent new species more material is needed to describe them properly. Five barcoded specimens are unplaced to species. One female from Ontario, Ancaster, 12-19.ix.1994, B. DeJonge, meadow prairie CNCHYM07514, which was initially identified as *O. longipetiolus* is very likely not this species because of a difference of 12 base pairs (Fig. 200). Other specimens from the same locality are treated as *O. longipetiolus* but with slight reservations because the groove on the mesoscutum and the petiole are somewhat shorter. Two males from Alberta, Beaverlodge area, Saskatoon Mt., 962m, 55°13.20′N 119°16.92′W, 25.vii. 2.viii.2007, J. Otani, natural meadow, sweeping, CNCHYM07480, CNCHYM07522 appear to be closest to *O. notatus* but differ by about 14 base pairs. Until females can be associated with them they cannot be described. Two specimens from Mexico (CNCHYM07520, CNCHYM07521) differ from species north of Mexico and will be described elsewhere.

Discussion

The following European material was examined: 141 *O. notatus*, 92 *O. hemipterus*, 66 *O. vulgatus*, 59 *O. insignis*, 5 *O. sublaevis*, and 4 *O. novickyi* Soyka [CNC, NMPC]. The first three of these species occur in North America, perhaps not surprisingly because they are the three most common and widespread European *Ooctonus* species. They appear to occur mainly in open, man-made habitats and the host of one, *O. vulgatus*, is a widespread European introduction in North America, occurring mainly in agricultural habitats. Likely, all are accidental introductions, not naturally Holarctic species. The last three species have not been found in North America. *Ooctonus insignis*, the largest European *Ooctonus*, might also have been expected to occur there as an accidental introduction because it is almost as common (based on collected material seen) as *O. vulgatus* but so far I have not seen North American specimens. The two remaining European species do not occur in North America. This is not surprising because they appear to be rare in Europe so the possibility of accidental human transport is small. So far none of the eastern Palearctic or Oriental species have been found in North America. However, the eastern Palaearctic species *O. orientalis* Doutt

resembles *O. canadensis*, and *O. spartak* Triapitsyn resembles *O. occidentalis*, suggesting a closer association of some western North American *Ooctonus* to eastern Asian species than to eastern North American and European species.

Males are very difficult or impossible to identify confidently based on morphology. It was hoped that barcoding would help associate males with females. If all 64 specimens submitted for barcoding at the Biodiversity Institute of Ontario had yielded barcodes of reasonable length (at least 200 base pairs) it is likely that the males would have been associated correctly with corresponding females. But only 33 of 64 (52%) specimens yielded such barcodes. An additional specimen barcoded by Guelph (09BBHYM696) is included in the Neighbour-joining tree (Fig. 200); it is a specimen of *O. silvensis*. Bar codes corresponded to the species identities based on morphological characters, and helped to correct identification errors based on morphology. In one case, the series of three male specimens successfully barcoded contained two specimens of *O. occidentalis* (correctly identified, based on morphology) and one of *O. canadensis* (initially misidentified as *O. occidentalis*). In the second case, a male of *O. notatus* was misidentified as a male of *O. boltei* but their bar codes were identical so they are clearly the same species and I assigned them to *O. notatus*. In the third case, a barcode divergence of 4% suggested two species within *O. longipetiolus*.

No barcodes were obtained for two males that I could not place to species based on morphology or by association with females. One male (CNC) with the same collection data as a specimen of *O. hemipterus*, namely, Cantwell, Denali hwy, route 8, mi. 85-130, 24.vii.1984, S. & J. Peck, taiga-tundra, car netting, CNCHYM07524 [barcode failed] is clearly not *O. hemipterus* based on morphology. And one male (CNC) from Alberta, Edmonton, 22.viii.1984, T.G. Spanton, CNCHYM07526 [barcode failed] also cannot be identified to species.

On the basis of morphology and/or barcodes more species of *Ooctonus* occur in North America north of Mexico than are treated here. Much more material is needed to be able to describe them meaningfully.

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TABLE 1. Abbreviations used in the figures descriptions. Codes in parentheses are entries in the Hymenoptera Anatomy Ontology project website (HAO) [accessed 12 October, 2012], where applicable. Entries can be accessed using the structure http://purl.obolibrary.org/obo/HAO_XXXXXXX, where XXXXXXX is the HAO ID number.

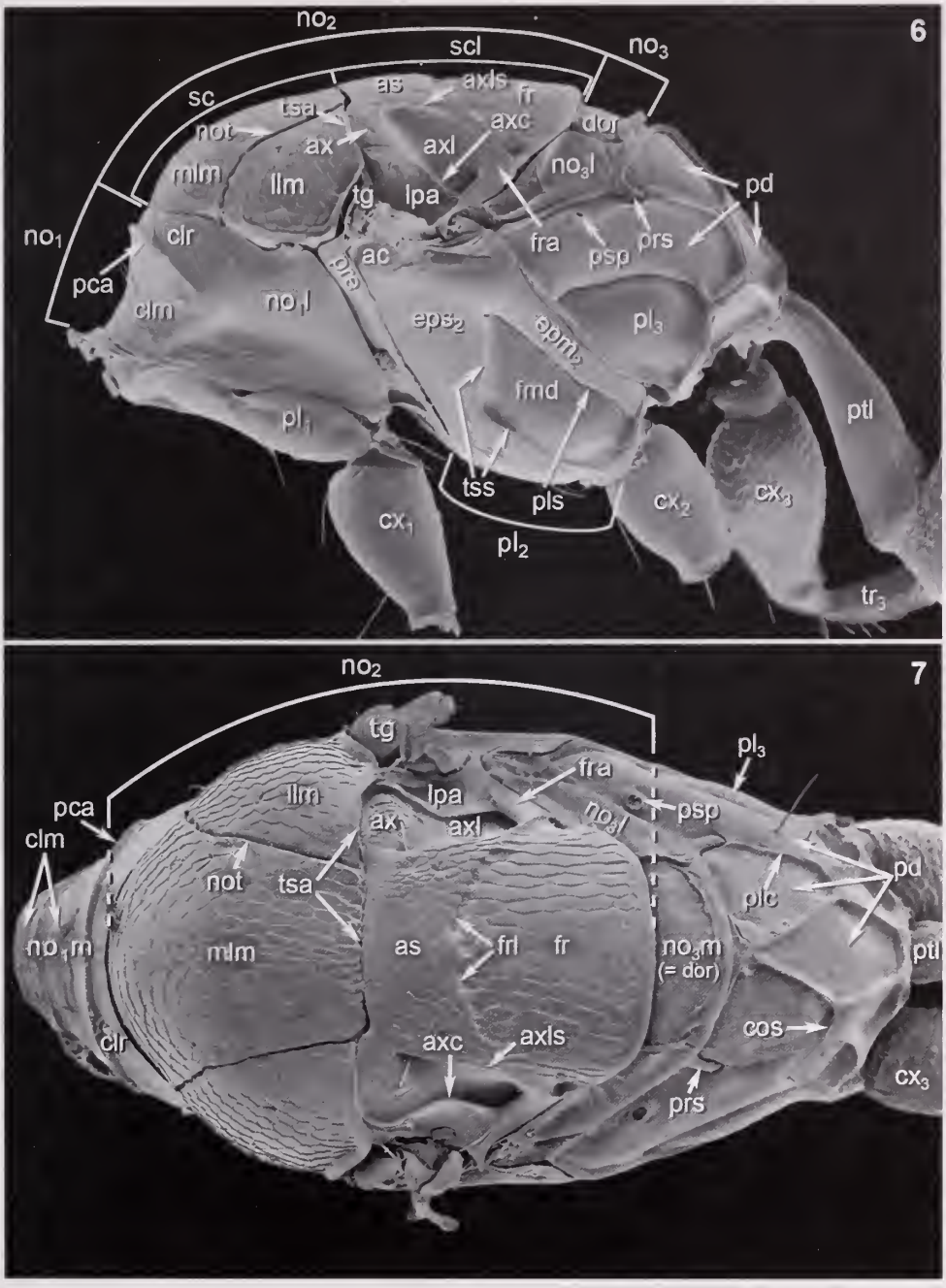
Body (Figs. 6–8, 195–199)
ac acropleuron (HAO_0001155)
as anterior scutellum (HAO_0001167)
ax axilla (HAO_0000155)
axc axillar carina (HAO_0000156)
axl axillula (HAO_0000160)
axls axillular sulcus/carina (HAO_0001159)
brf1 basal ring of femur (= trochantellus) (HAO_0001033)
clm collum (= neck) (HAO_0000837)
clr collar (HAO_0000832)
cos costula (HAO_0000486)
cx1 procoxa (HAO_0001122)
cx2 mesocoxa (HAO_0000635)
cx3 metacoxa (HAO_0000587)
dc1 prodiscrimen (HAO_0000823)
dc2 mesodiscrimen (HAO_0000545)
dor = no3m dorsellum (= metascutellum or mid panel of metanotum) (HAO_0000625)
epm2 mesepimeron (HAO_0000539)
eps2 mesepisternum (HAO_0000541)
fln funicle segment (females) or flagellomere (males) (HAO_0000342)
fmd femoral depression (HAO_0000326)
fr frenum (= posterior scutellum) (HAO_0000355)
fra frenal arm (HAO_0001903)
frl frenal line (HAO_0000354)
fu2p mesofurcal pit (HAO_0000549)
gsn gastral sternum (HAO_0002023)
gtn gastral tergum (HAO_0002024)
llm lateral lobe of mesoscutum (HAO_0000466)
LOL least ocellar length (Fig. 52) (HAO_0000480)
lpa lateral panel of axilla (HAO_0000468)
mlm midlobe of mesoscutum (HAO_0000520)
mps multiporous plate sensilla (= longitudinal sensilla, of authors) (Fig. 76) (HAO_0001936)
mtp metatrochantinal plate (HAO_0000588)
not notaulus (HAO_0000647)
no1 pronotum (HAO_0000853)
no1l lateral panel of pronotum (HAO_0002025)
no1m midlobe of pronotum
no2 mesonotum (HAO_0000556)
no3 metanotum (HAO_0000603)
no3l lateral panel of metanotum (HAO_0000600)
no3m = dor mid panel of metanotum (= metascutellum = dorsellum) (HAO_0000625)
od mid ocellar diameter (Fig. 53) (HAO_0002027)

TABLE 1 continued...

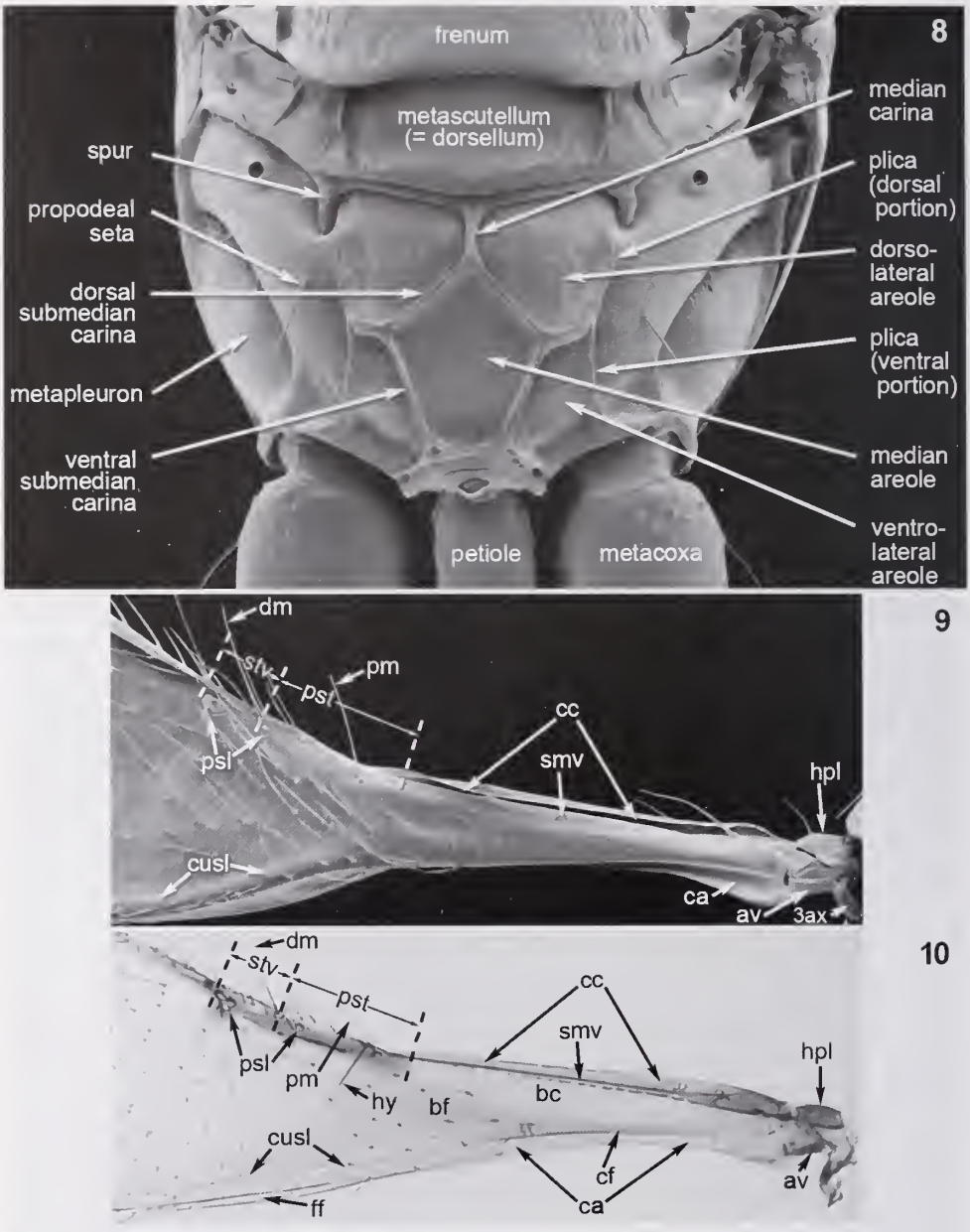
OOL ocular-ocellar length (Fig. 52) (HAO_0000662)
ovip ovipositor (HAO_0000679)
pca pronotal carina (HAO_0001031)
pd propodeum (HAO_0001248)
phl phallobase (HAO_0000713)
plc plica (HAO_0000735)
pls mesopleural suture (HAO_0001706)
pl1 propleuron (HAO_0000862)
pl2 mesopleuron (HAO_0000566)
pl3 metapleuron (HAO_0001272)
POL postocellar length (Fig. 52) (HAO_0000759)
pre prepectus (HAO_0000811)
prs propodeal stub
psp propodeal spiracle (HAO_0000329)
ptl petiole (HAO_0000020)
sc mesoscutum (= mlm + llm) (HAO_0001490)
scl mesoscutellum (HAO_0000574)
st1 prosternum (HAO_0000873)
st2 mesopleurosternum (HAO_0001710)
tg tegula (HAO_0000993)
tr1 protrochanter (HAO_0001123)
tr2 mesotrochanter (HAO_0001130)
tr3 metatrochanter (HAO_0001139)
tsa transscutal articulation (HAO_0001204)
tss transepisternal suture (HAO_0001205)

Fore wing (Figs. 9, 10)
av anal vein (HAO_0000093)
ax 3rd axillary sclerite (HAO_0001009)
bc basal cell
bf basal fold
ca claval area (clavus) [(vannal area of Gibson (2004)]
cf claval fold/claval flexion line
cc costal cell
cusl cubital line of setae
dm distal macrochaeta
ff frenal fold [subcubital fold of Gibson (2004)]
hpl humeral plate (HAO_0000403)
hy hypochaeta
pm proximal macrochaeta
psl placoid sensilla
pst parastigma
smv submarginal vein
stv stigmal vein

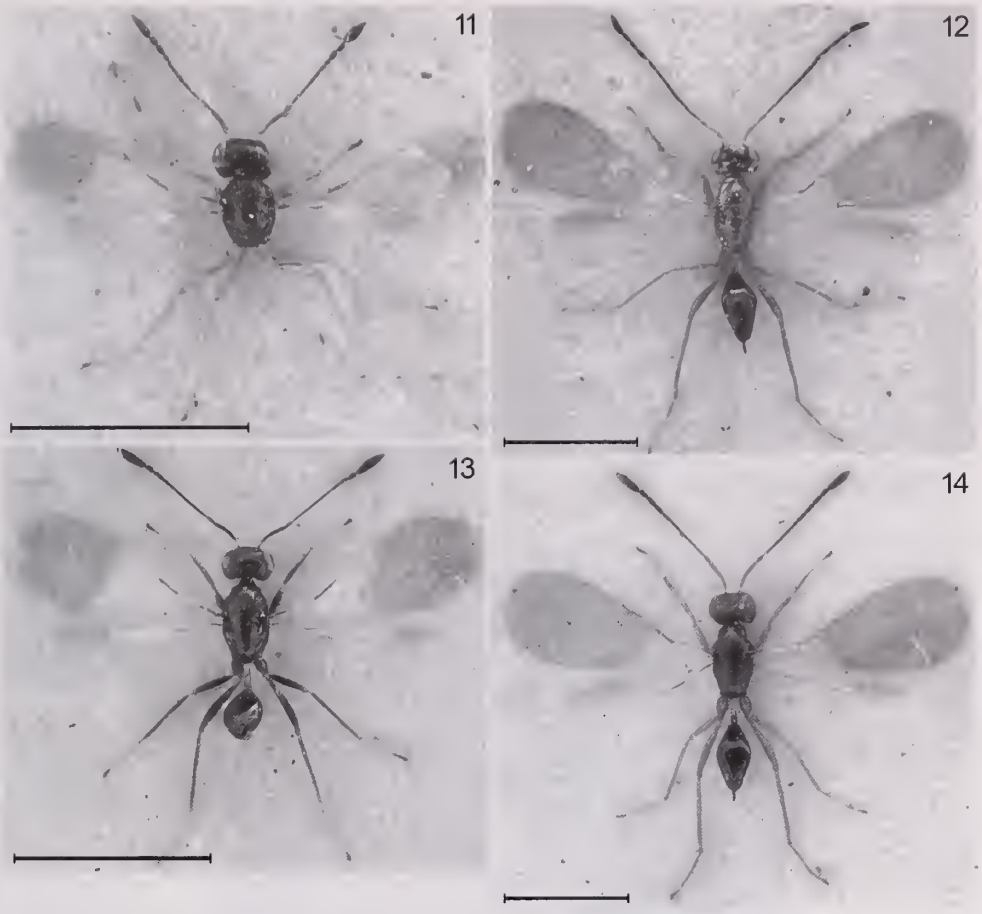
FIGURES 1–5. *Ooctonus* females, lateral habitus. 1, *hemipterus*, short winged specimen; 2, *readae*; 3, *quadricarinatus*; 4, *silvensis*; 5, *vulgatus*. Scale bars are 1000 μm.



FIGURES 6, 7. *Ooctonus* spp., scanning electron micrographs (SEM). 6, *quadricarinatus* mesosoma, coxae, and petiole, lateral; 7, *quadricarinatus*, mesosoma, dorsal. See Table 1 for terms.

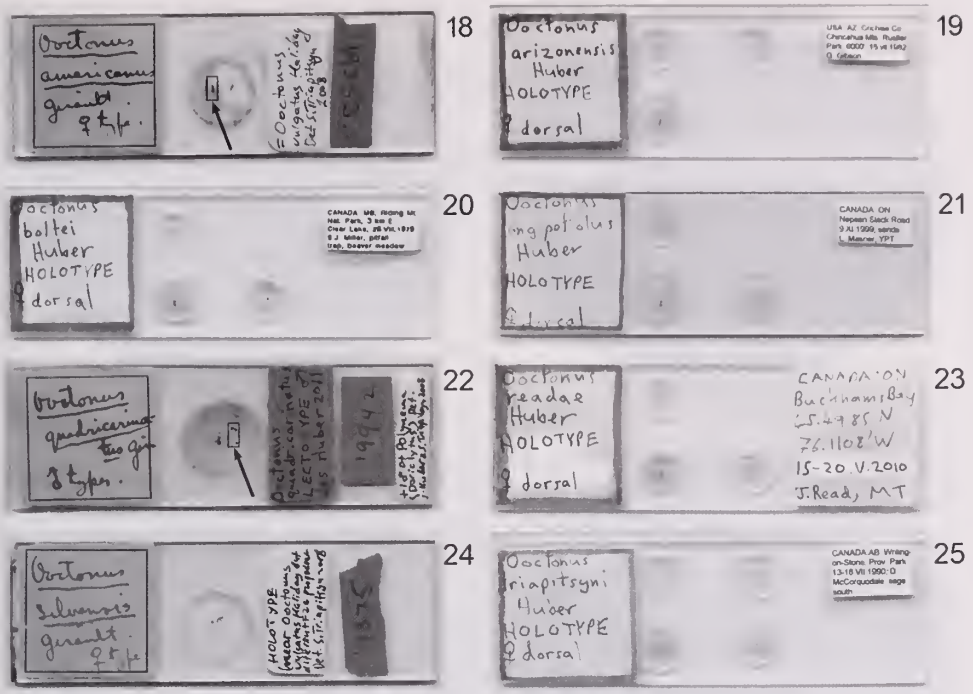


FIGURES 8–10. *Ooctonus* spp. 8, *readae*, propodeum, dorsal, SEM; 9, *longipetiolus*, fore wing base, dorsal, SEM; 10, *readae*, fore wing base, transmitted light. See Table 1 for terms.

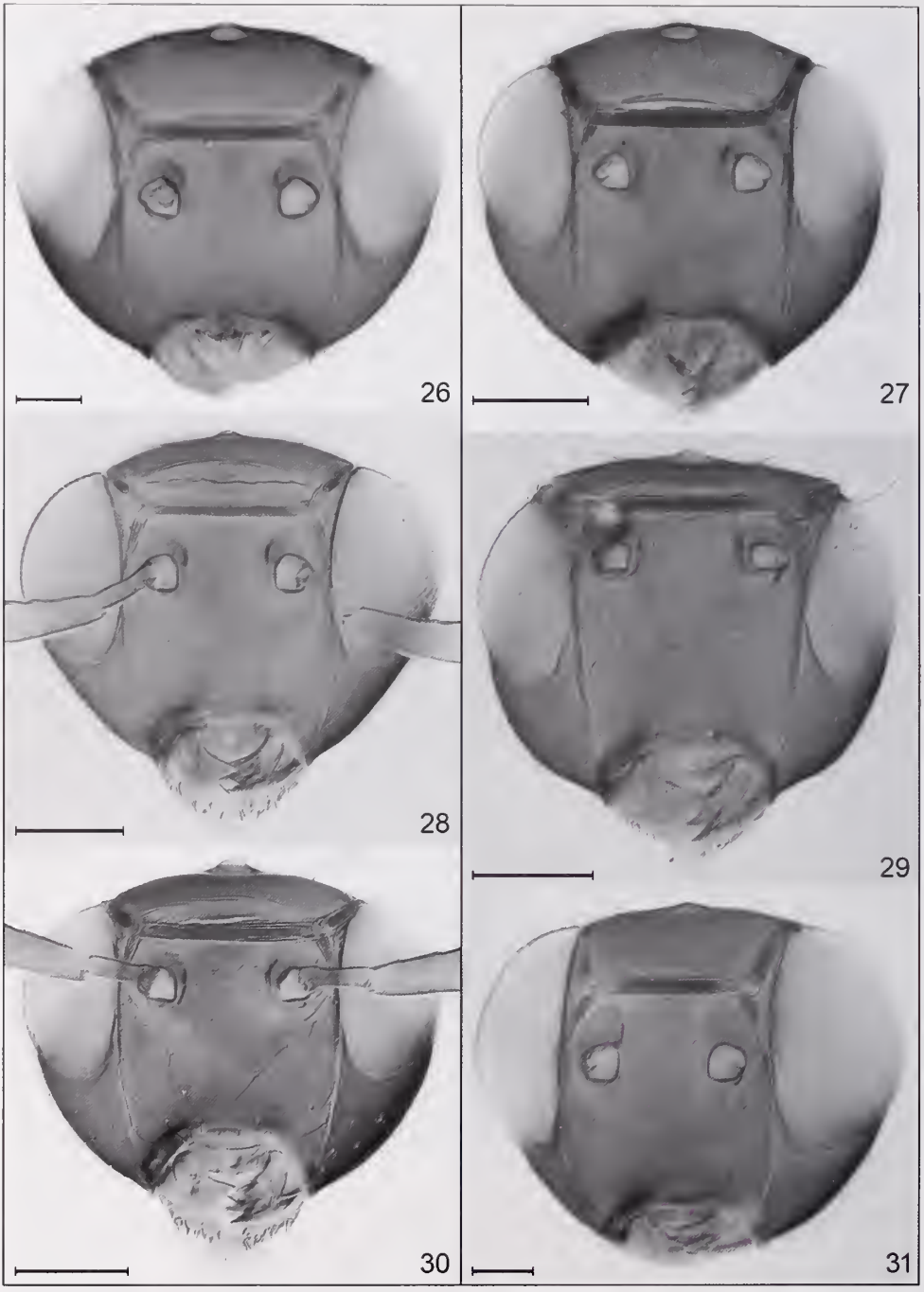


FIGURES 11–14. *Ooctonus* spp., lectotoypes. 11, *auripes*; 12, *canadensis*; 13, *fuscipes*; 14, *occidentalis*. Scale bars are 1000 μm.

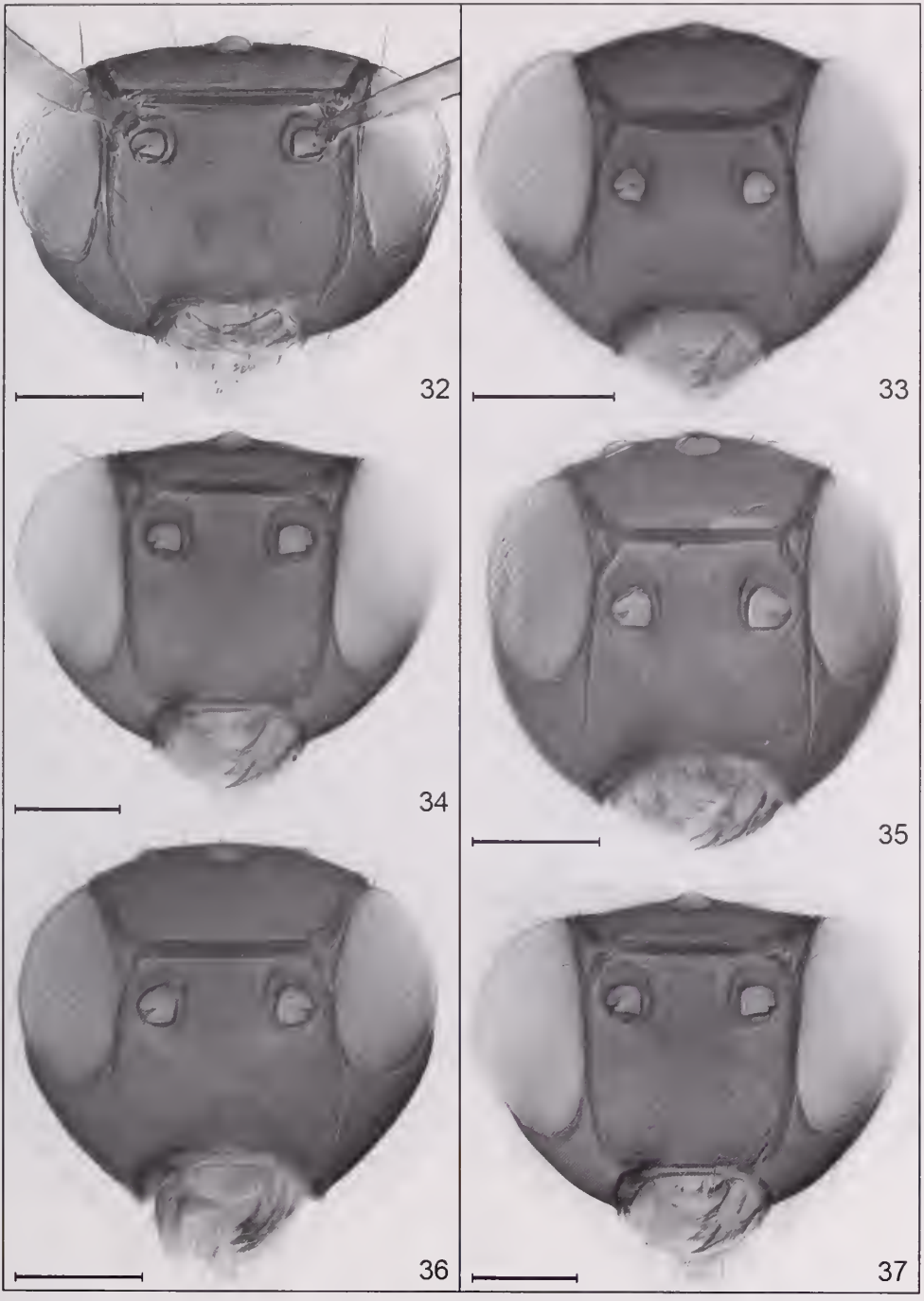
FIGURES 15–17. *Ooctonus* spp., primary types. 15, *americanus*, holotype; 16, *silvensis*, holotype; 17, *quadricarinatus*, lectotype. Scale bars are 1000 μm.



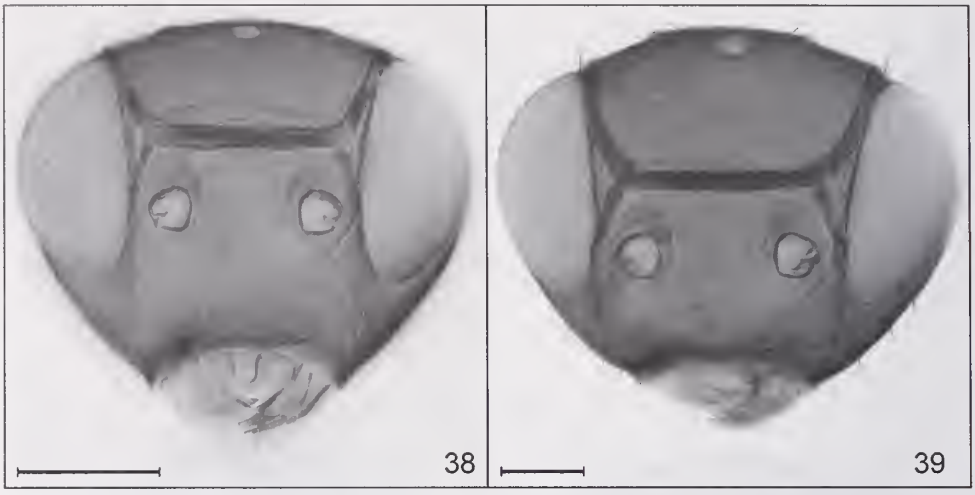
FIGURES 18–25. *Ooctonus* spp., primary type slides. 18, *americanus*; 19, *arizonensis*; 20, *boltei*; 21, *longipetiolus*; 22, *quadricarinatus*; 23, *readae*; 24, *silvensis*; 25, *triapitsyni*.



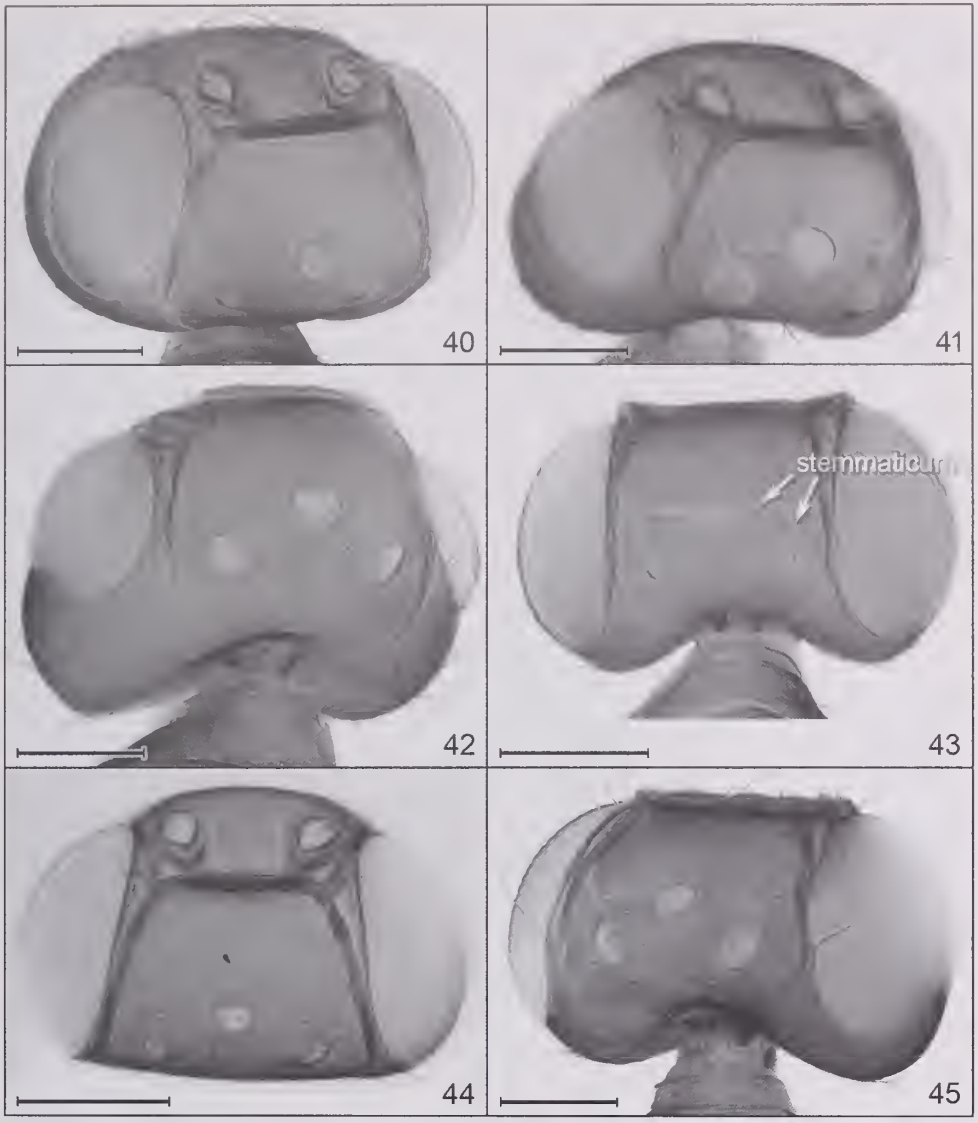
FIGURES 26–31. *Ooctonus* females, head, anterior view. 26, *aphrophorae*; 27, *arizonensis*; 28, *boltei*, holotype; 29, *canadensis*; 30, *fuscipes*; 31, *hemipterus*. Scale bars are 100 µm.



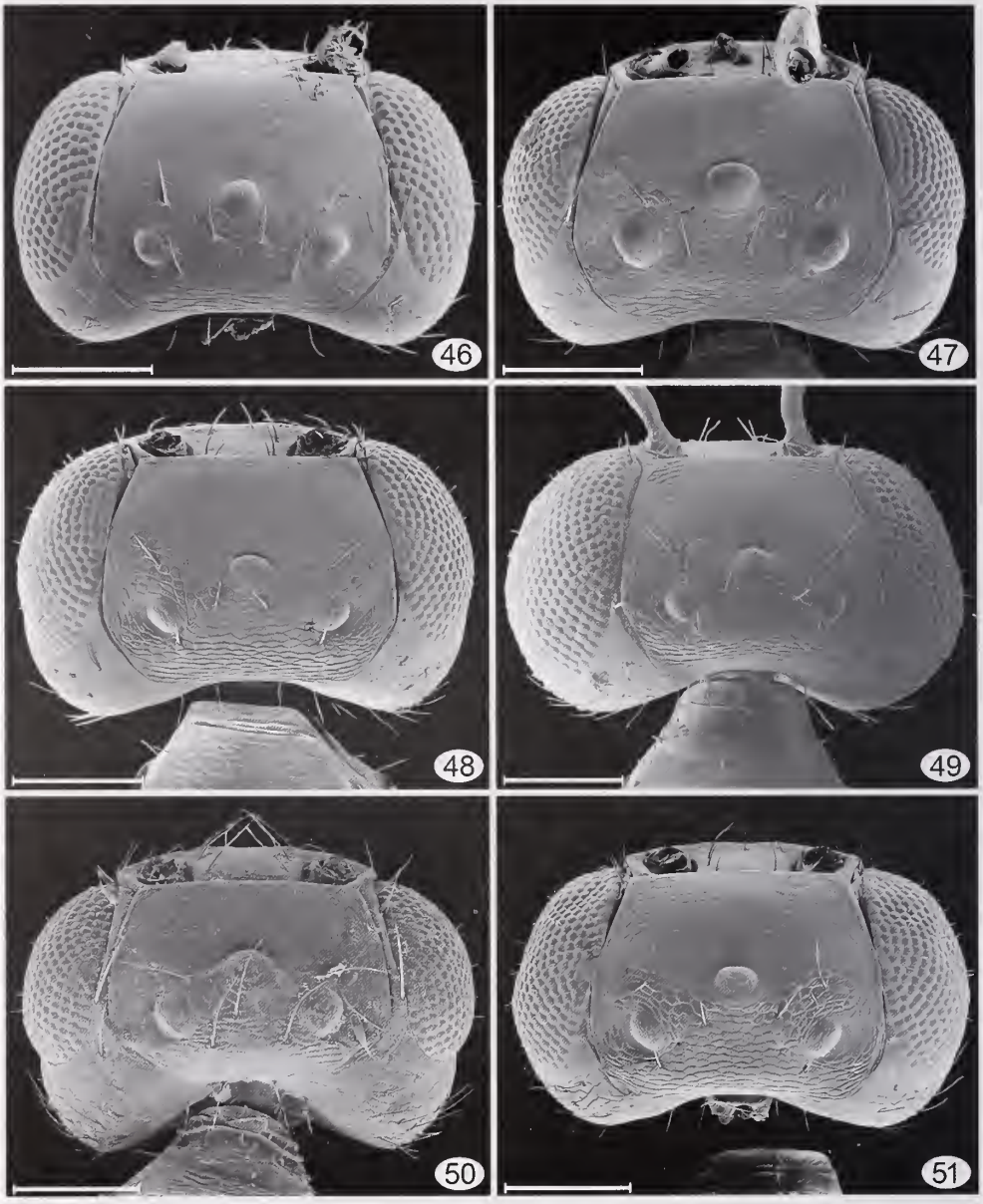
FIGURES 32–37. *Ooctonus* females, head, anterior view. 32, *longipetiolus*, holotype; 33, *notatus*; 34, *occidentalis*; 35, *quadricarinatus*; 36, *readae*; 37, *silvensis*. Scale bars are 100 μm.



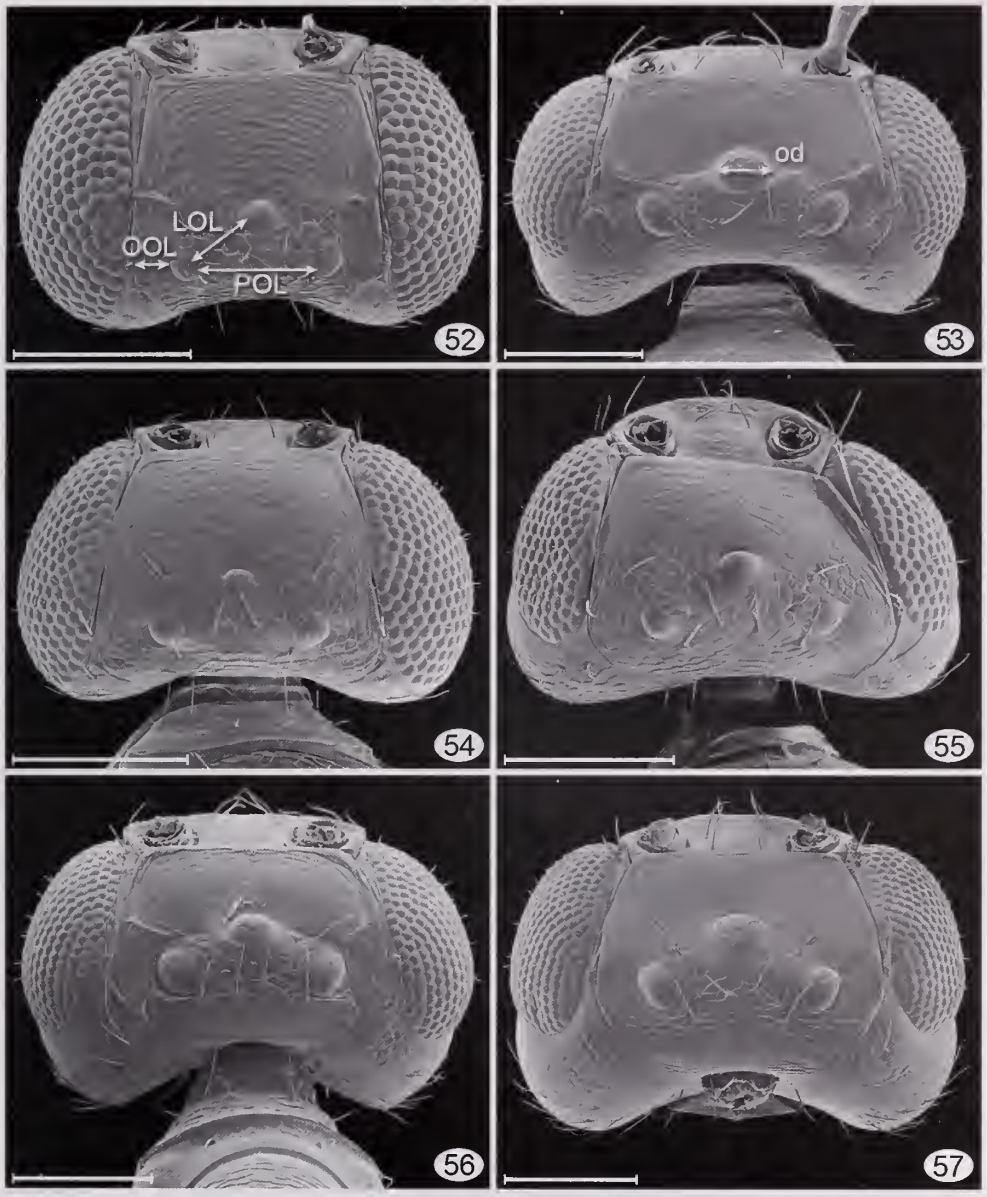
FIGURES 38, 39. *Ooctonus* females, heads, anterior view. 38, *triapitsyni*; 39, *vulgatus*. Scale bars are 100 μm.



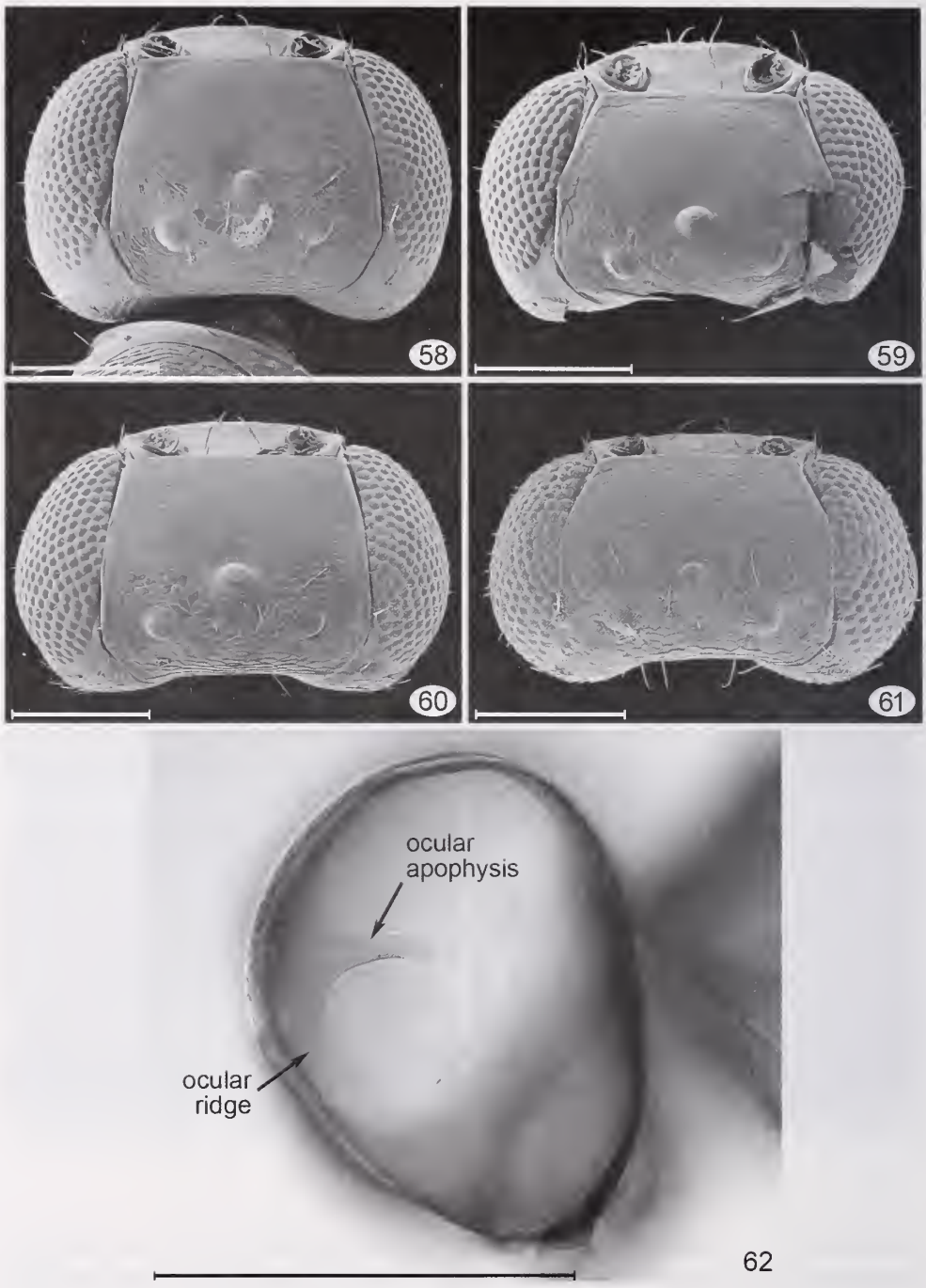
FIGURES 40–45. *Ooctonus* females (except as noted), heads, dorsal view. 40, *arizonensis*, holotype; 41, *canadensis*, male; 42, *fuscipes*, male; 43, *hemipterus*; 44, *notatus*; 45, *occidentalis*. Scale bars are 100 µm.



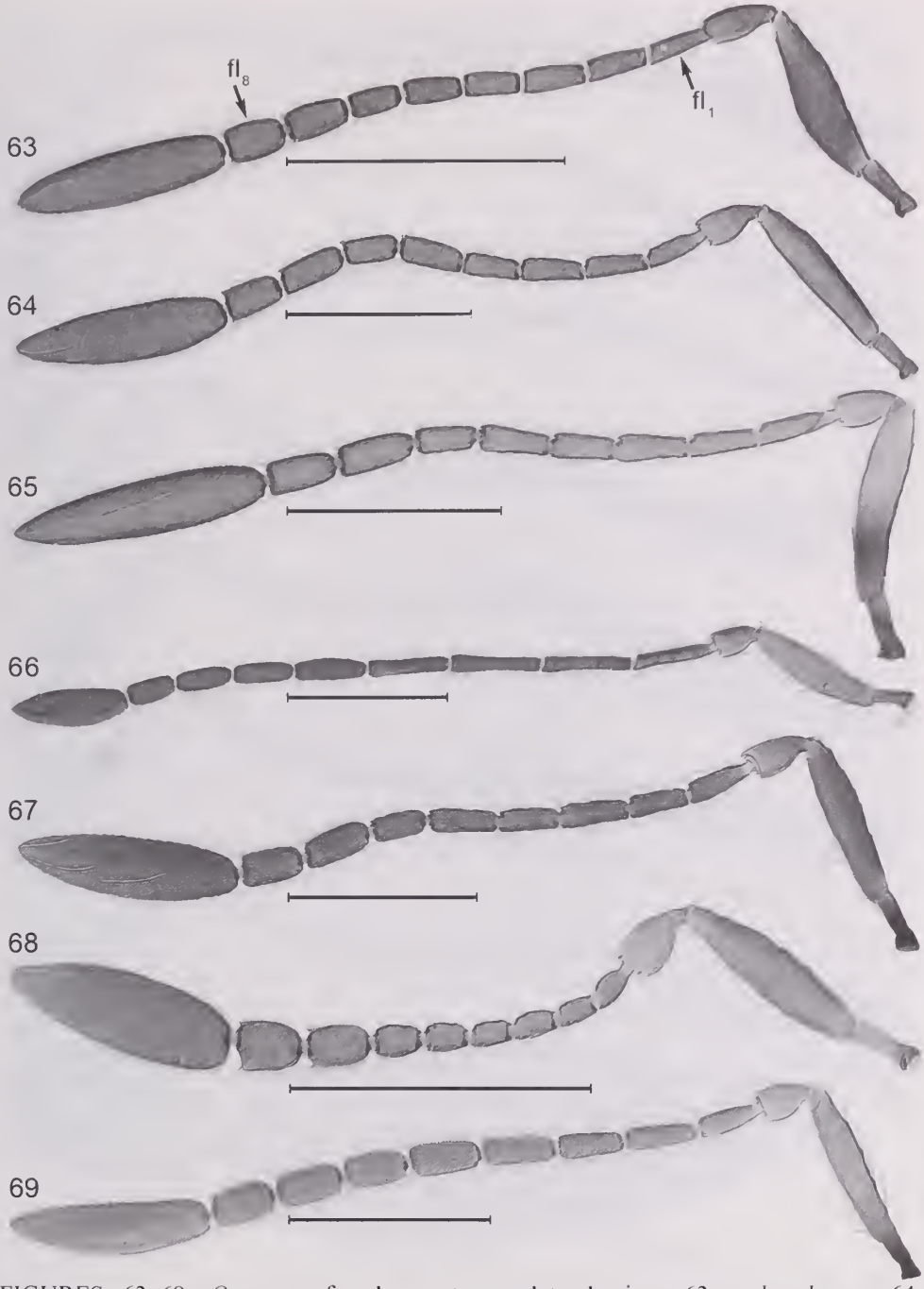
FIGURES 46–51. *Ooctonus* females (except as noted), head, dorsal view, SEM. 46, *aphrophorae*; 47, *aphrophorae*, male; 48, *arizonensis*, male; 49, *boltei*; 50, *canadensis*, male; 51, *fuscipes*. Scale bars are 100 μm.



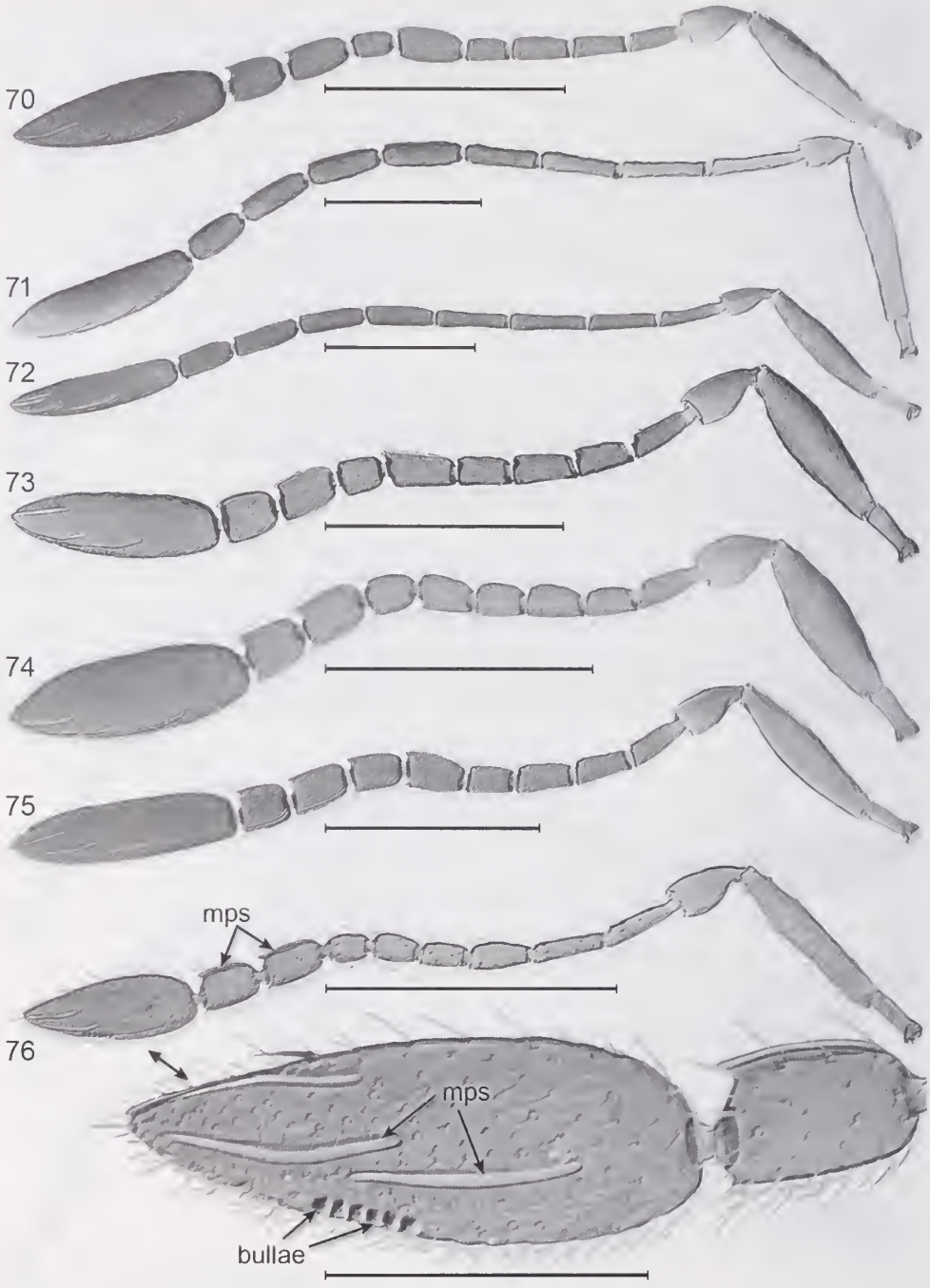
FIGURES 52–57. *Ooctonus* females (except as noted), head, dorsal view, SEM. 52, *hemipterus*; 53, *longipetiolus*, male; 54, *notatus*; 55, *notatus*, male; 56, *occidentalis*, male; 57, *quadricarinatus*, male. Scale bars are 100 μm.



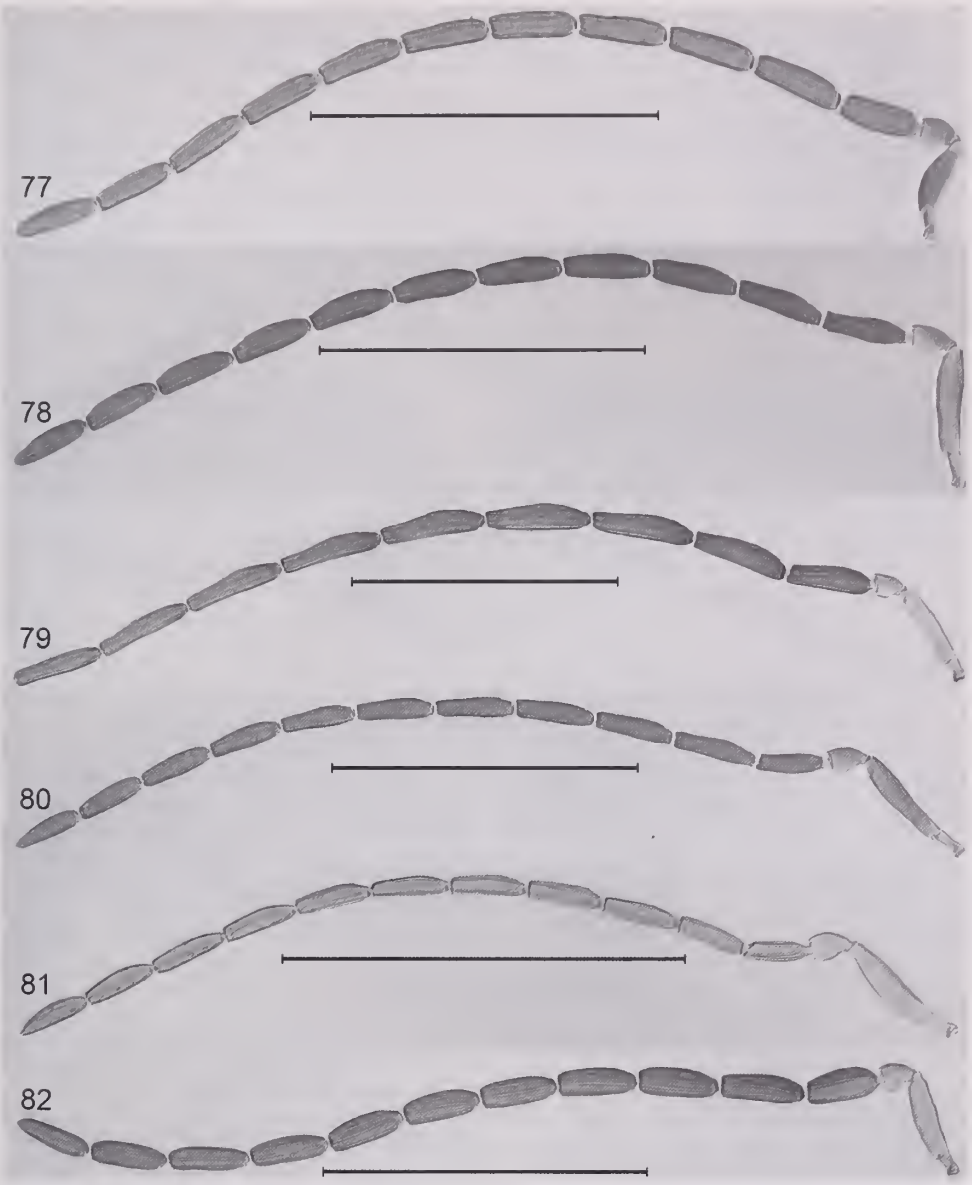
FIGURES 58–62. *Ooctonus* females, head, dorsal view, SEM (except Fig. 62). 58, *readae*; 59, *silvensis*; 60, *triapitsyni*; 61, *vulgatus*; 62, *hemipterus*, lateral view, transmitted light. Scale bars are 100 μm.



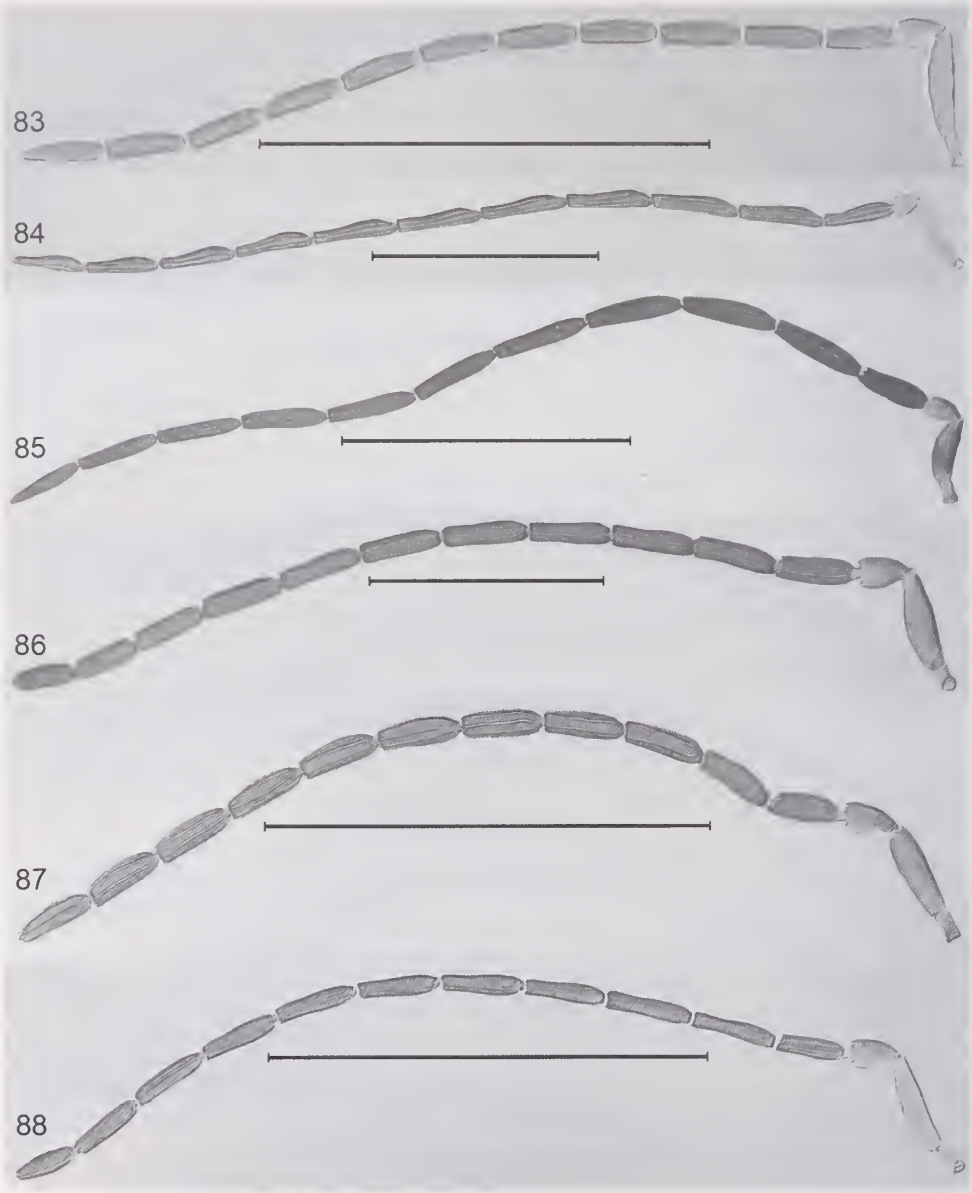
FIGURES 63–69. *Ooctonus* females, antenna, lateral view. 63, *aphrophorae*; 64, *arizonensis*, holotype; 65, *boltei*, holotype; 66, *canadensis*; 67, *fuscipes*; 68, *hemipterus*; 69, *longipetiolus*, holotype. Scale bars are 200 μm.



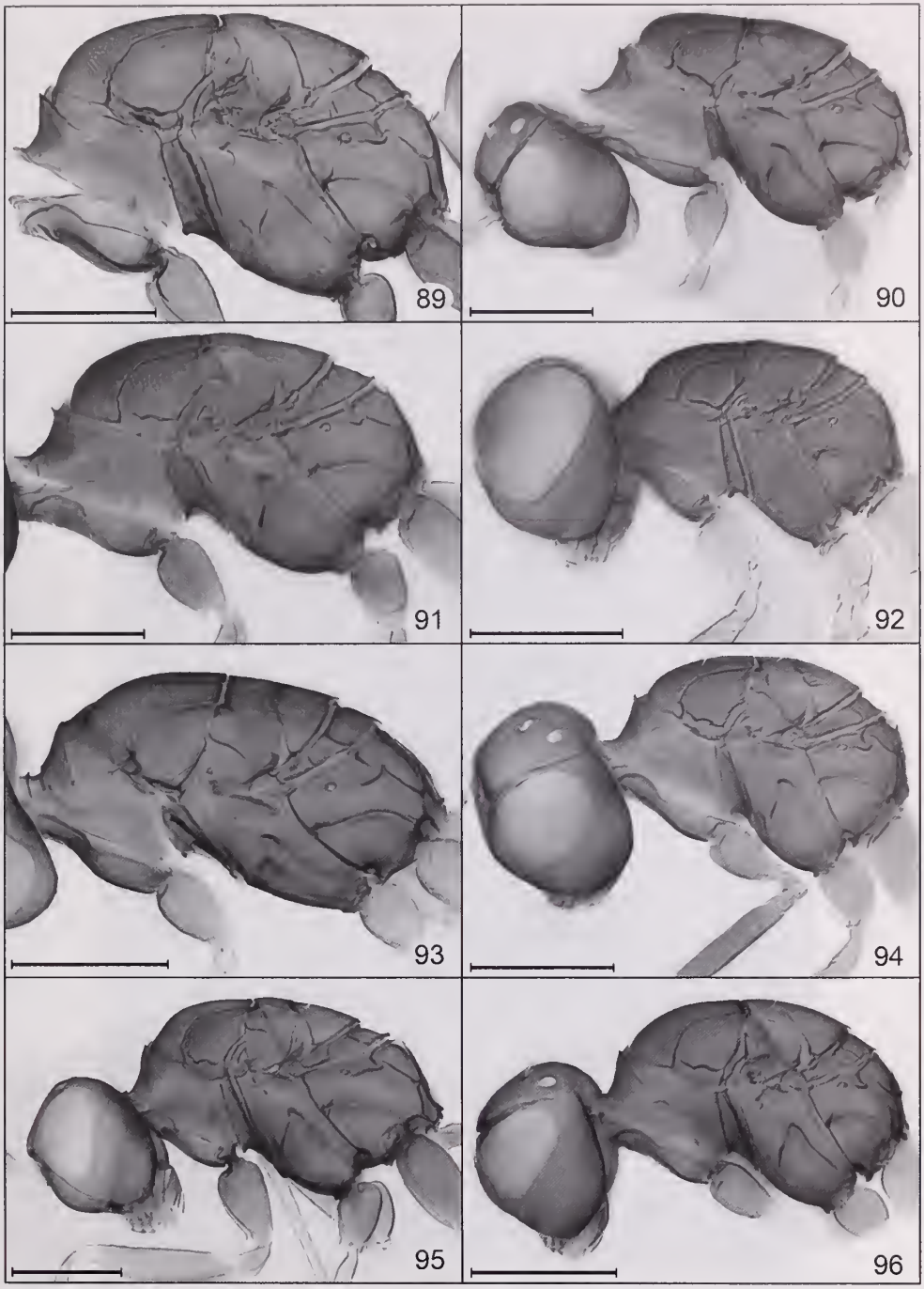
FIGURES 70–76. *Ooctonus* females, antenna, lateral view. 70, *notatus*; 71, *occidentalis*; 72, *quadricarinatus*; 73, *readae*; 74, *silvensis*; 75, *triapitsyni*; 76, *vulgatus* (inset is fl_8 + clava, showing row of six bullae). Scale bars are 200 μm; inset is 100 μm.



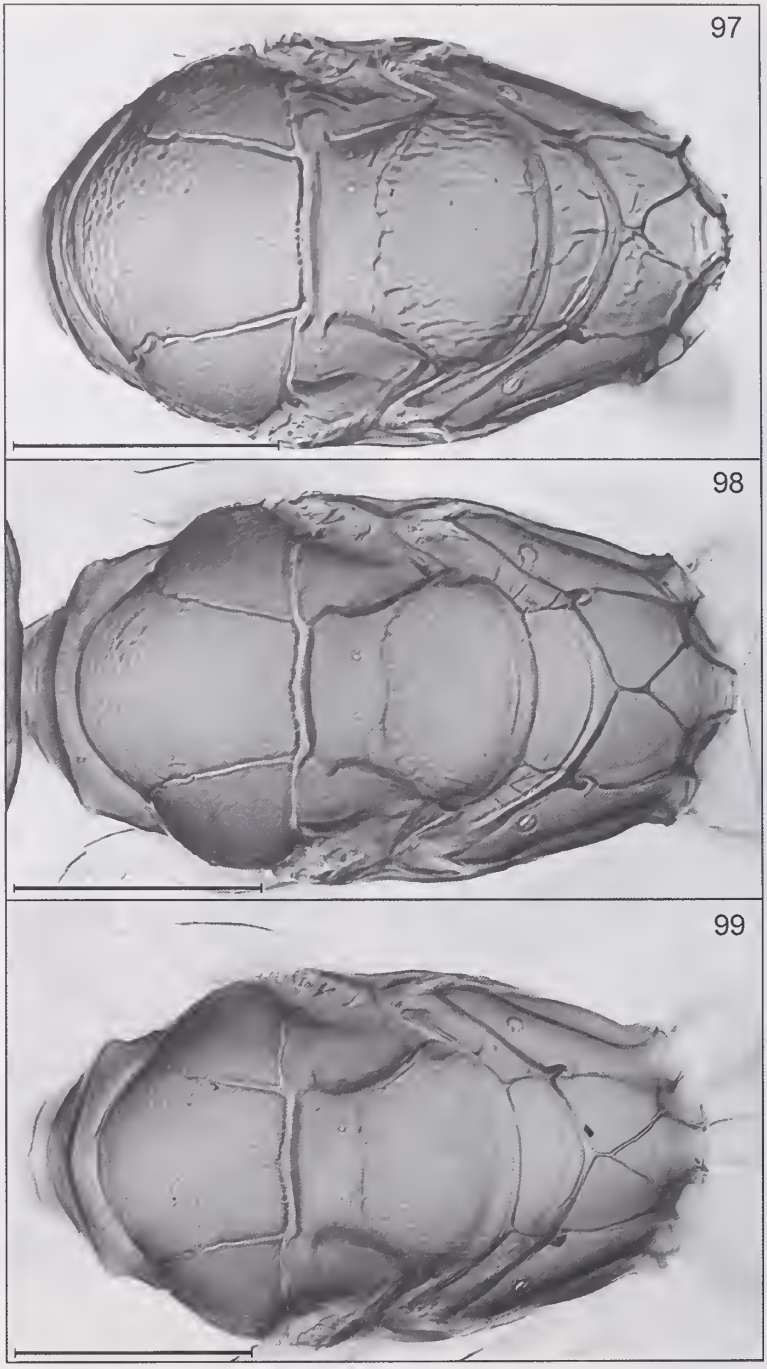
FIGURES 77–82. *Ooctonus* males, antenna, lateral view. 77, *aphrophorae*; 78, *arizonensis*; 79, *canadensis*; 80, *fuscipes*; 81, *hemipterus*; 82, *longipetiolus*. Scale bars are 500 μm.



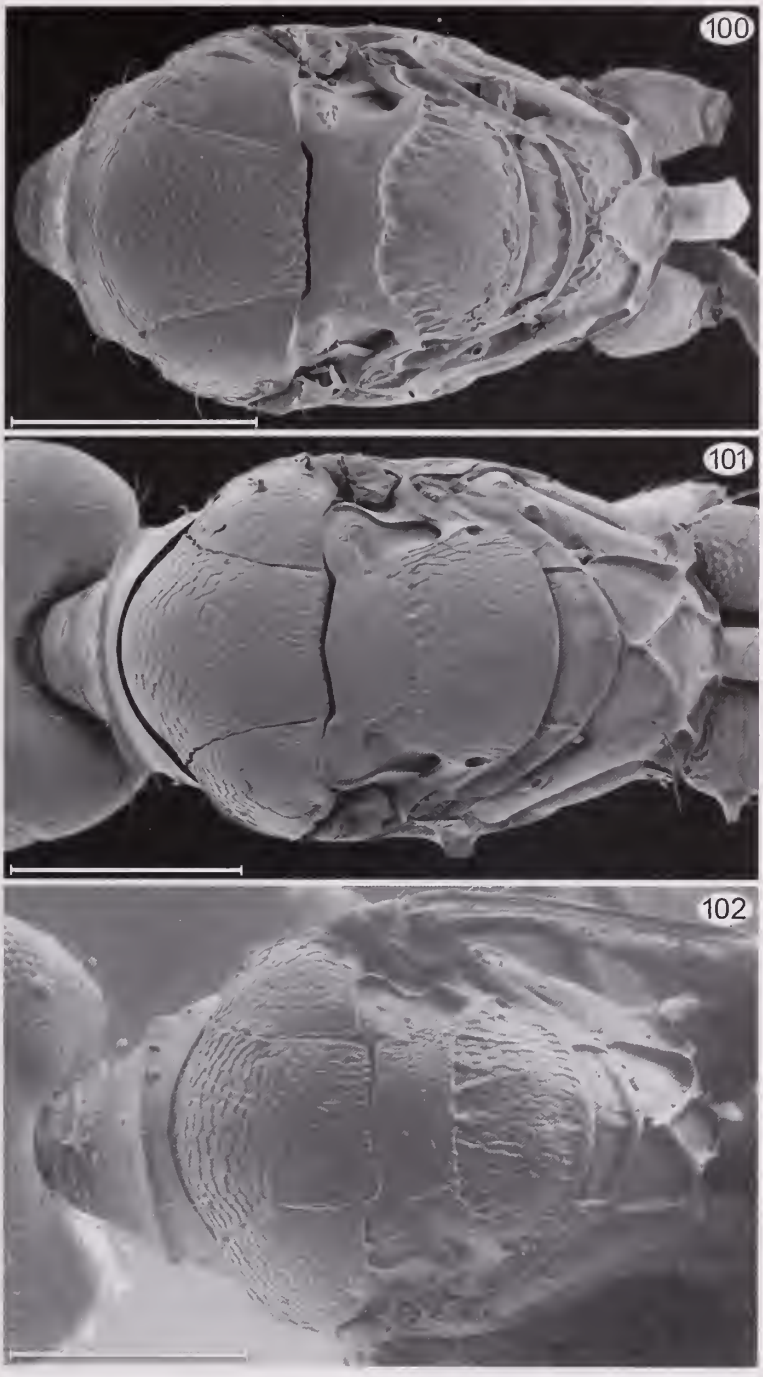
FIGURES 83–88. *Ooctonus* males, antenna, lateral view. 83, *notatus*; 84, *occidentalis*; 85, *quadricarinatus*, lectotype; 86, *readae*; 87, *silvensis*; 88, *vulgatus*. Scale bars are 500 μm.



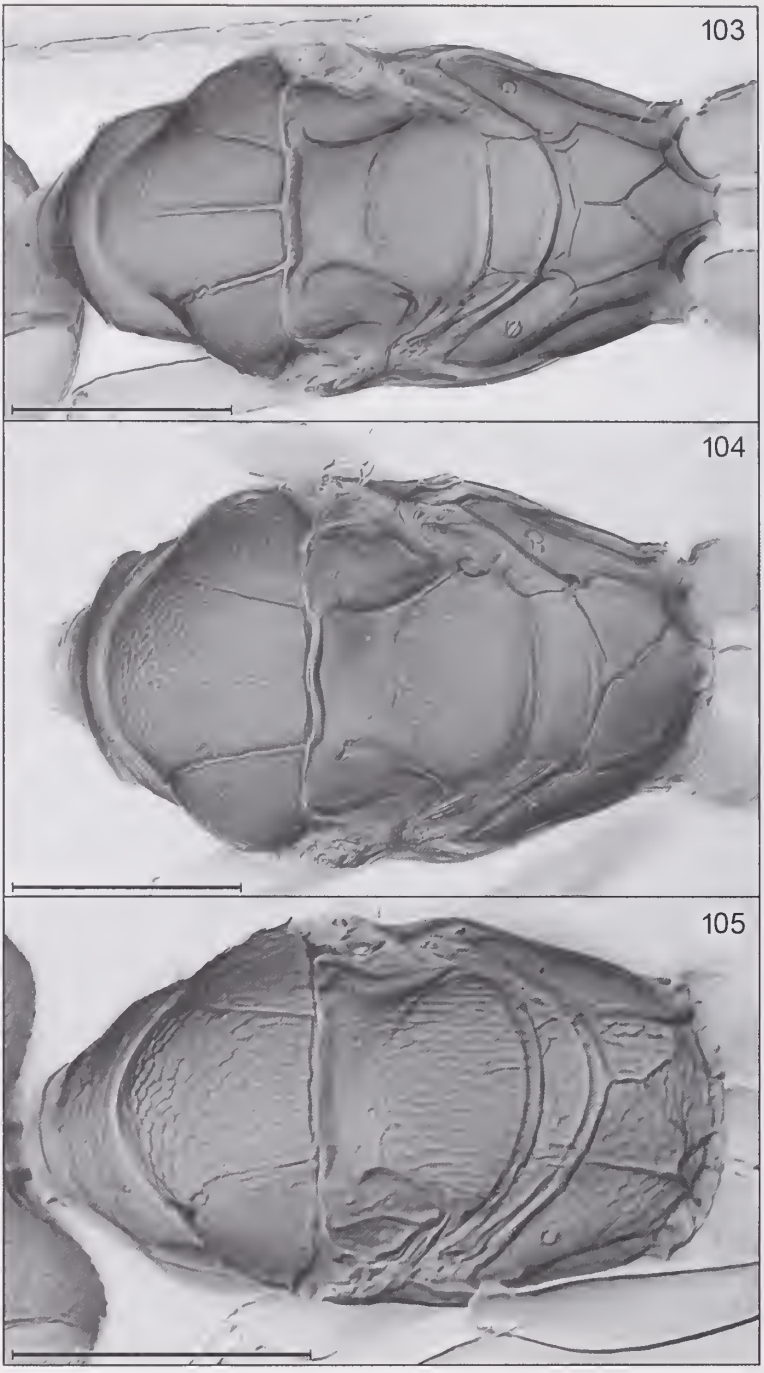
FIGURES 89–96. *Ooctonus* females (except as noted), mesosoma, lateral view. 89, *aphrophorae*, male; 90, *arizonensis*, male; 91, *fuscipes*, male; 92, *hemipterus*; 93, *longipetiolus*; 94, *readae*; 95, *quadricarinatus*; 96, *silvensis*. Scale bars are 200 μm.



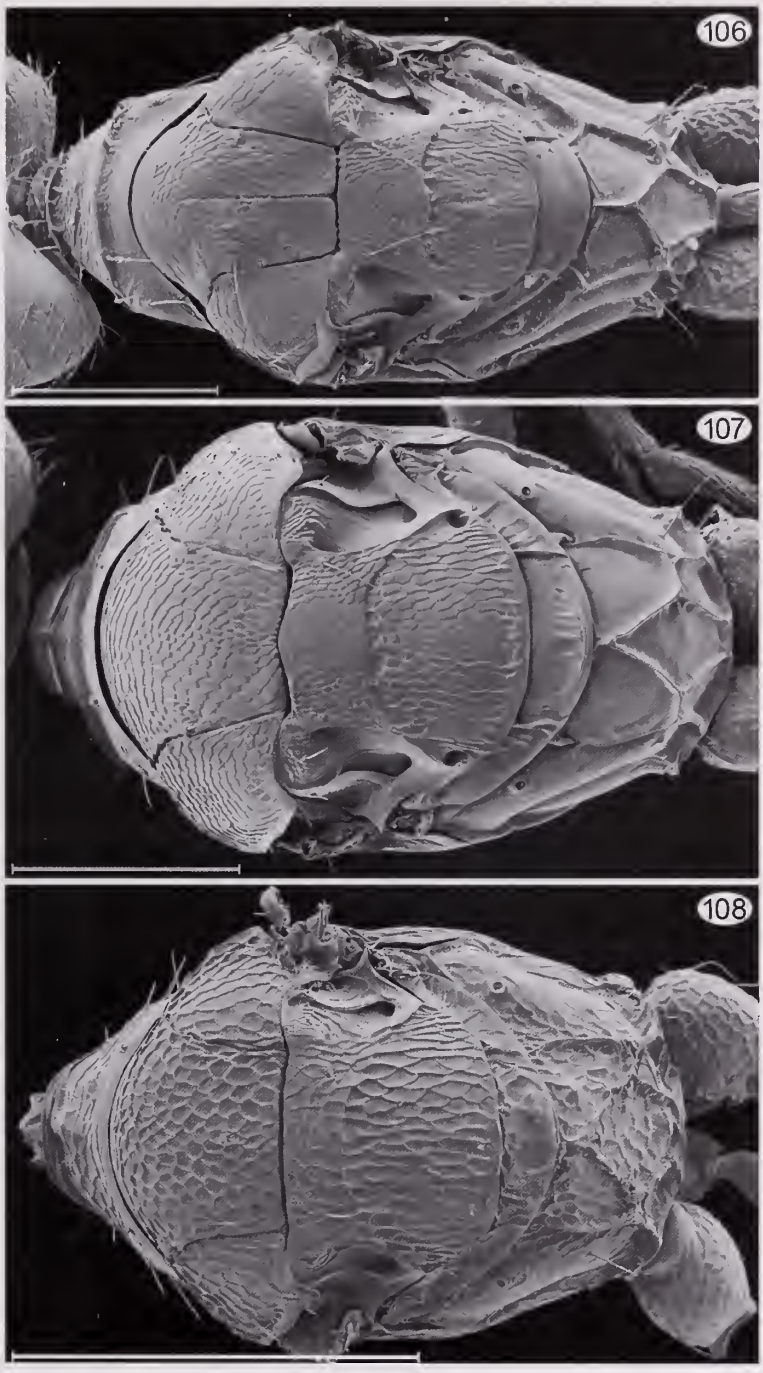
FIGURES 97–99. *Ooctonus* females, mesosoma, dorsal view. 97, *aphrophorae*; 98, *arizonensis*, holotype; 99, *boltei*, holotype. Scale bars are 200 μm.



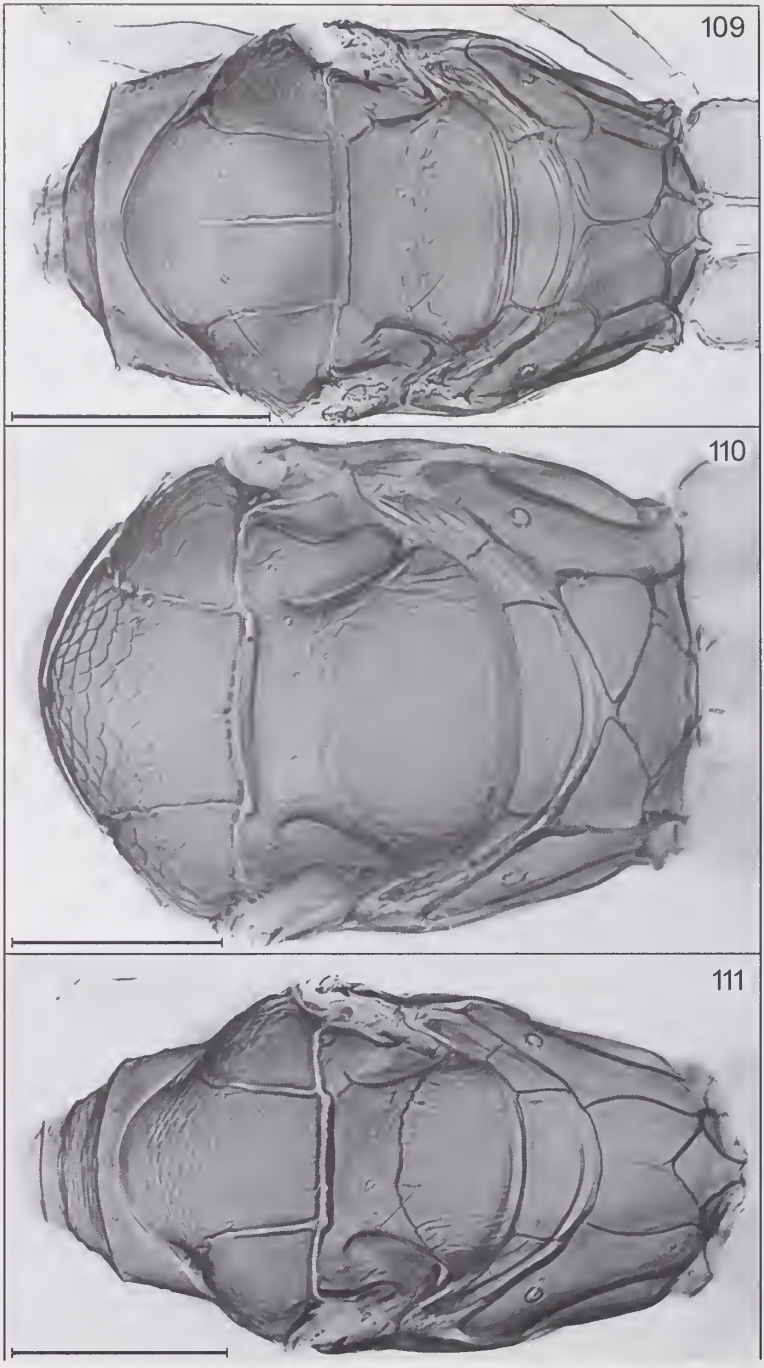
FIGURES 100–102. *Ooctonus* females (except as noted), mesosoma, dorsal view, SEM. 100, *aphrophorae*, male; 101, *arizonensis*; 102, *boltei*. Scale bars are 200 μm.



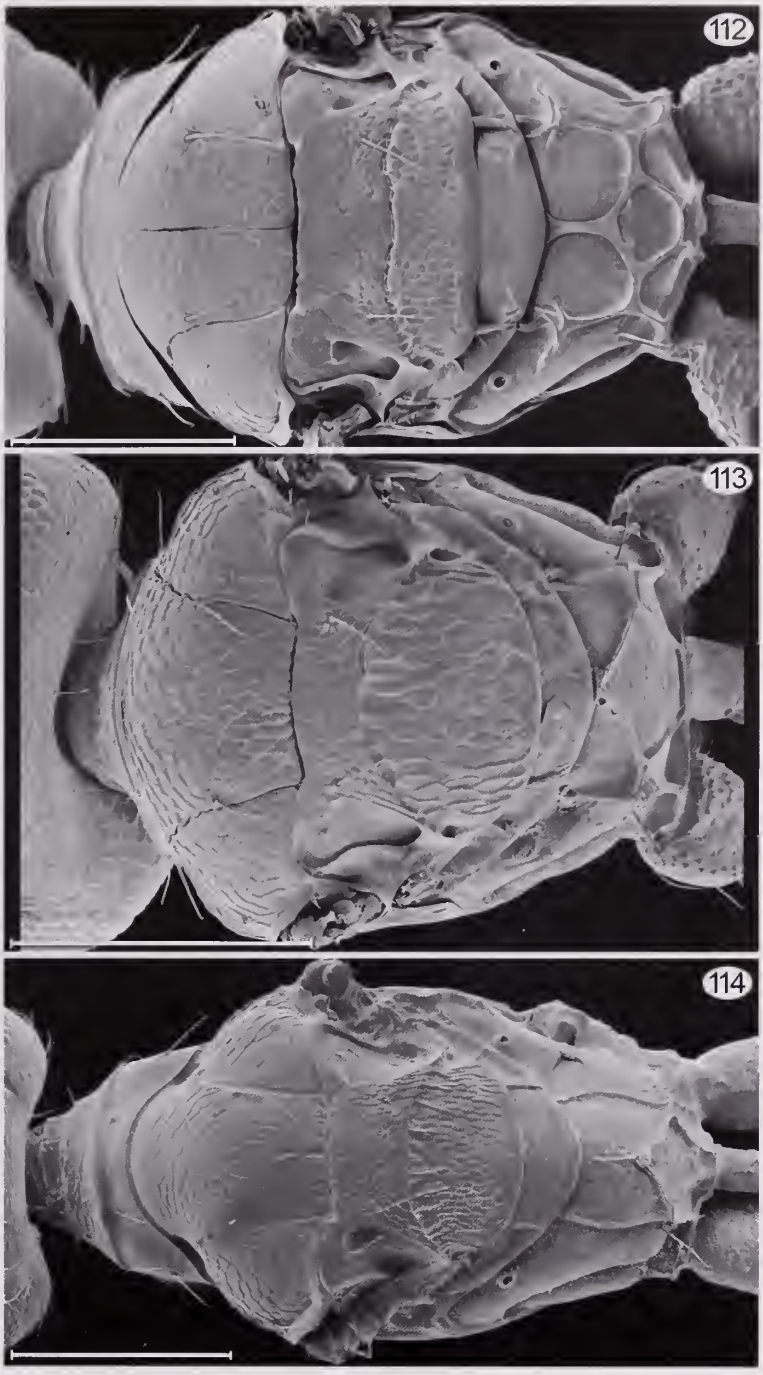
FIGURES 103–105. *Ooctonus* females, mesosoma, dorsal view. 103, *canadensis*; 104, *fuscipes*; 105, *hemipterus*. Scale bars are 200 μm.



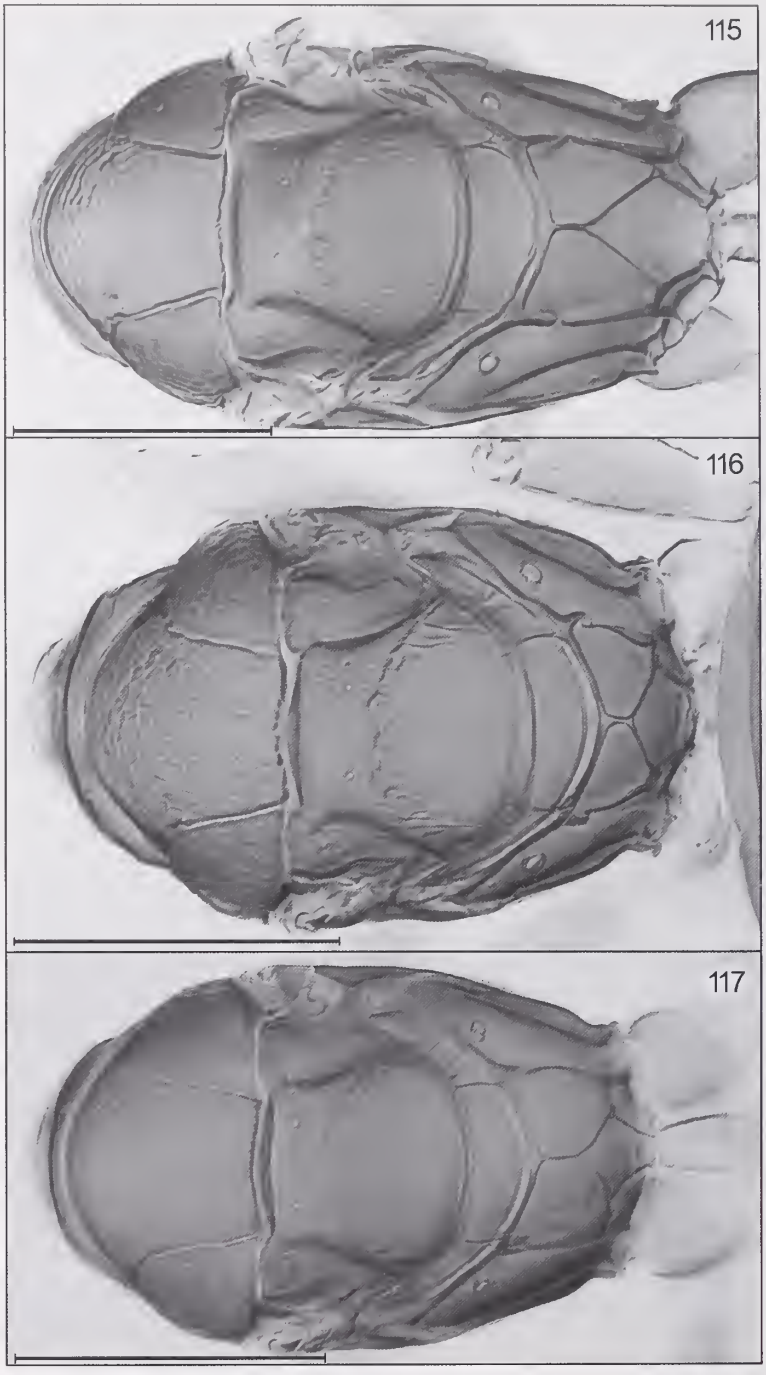
FIGURES 106–108. *Ooctonus* females (except as noted), mesosoma, dorsal view, SEM. 106, *canadensis*, male; 107, *fuscipes*; 108, *hemipterus*. Scale bars are 200 μm.



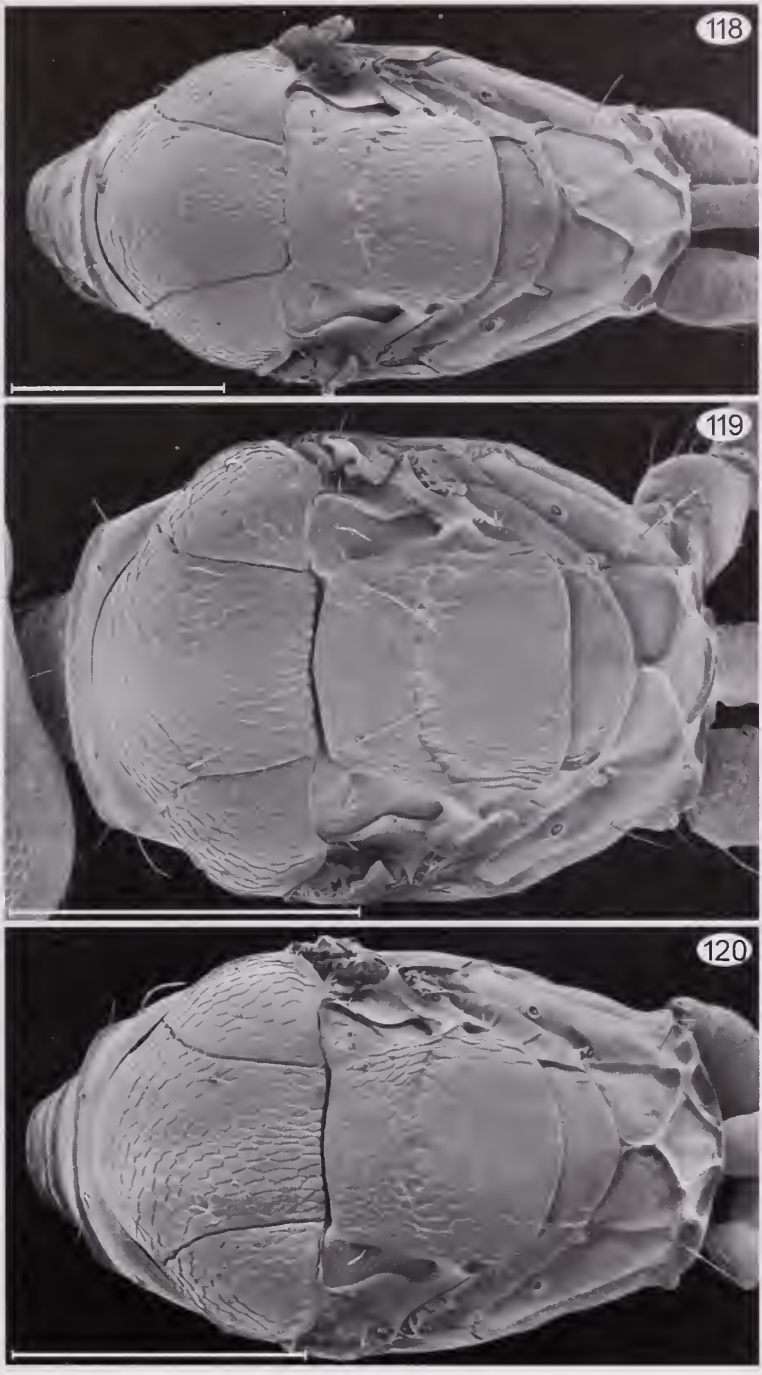
FIGURES 109–111. *Ooctonus* females, mesosoma, dorsal view. 109, *longipetiolus*, holotype; 110, *notatus*; 111, *occidentalis*. Scale bars are 200 μm.



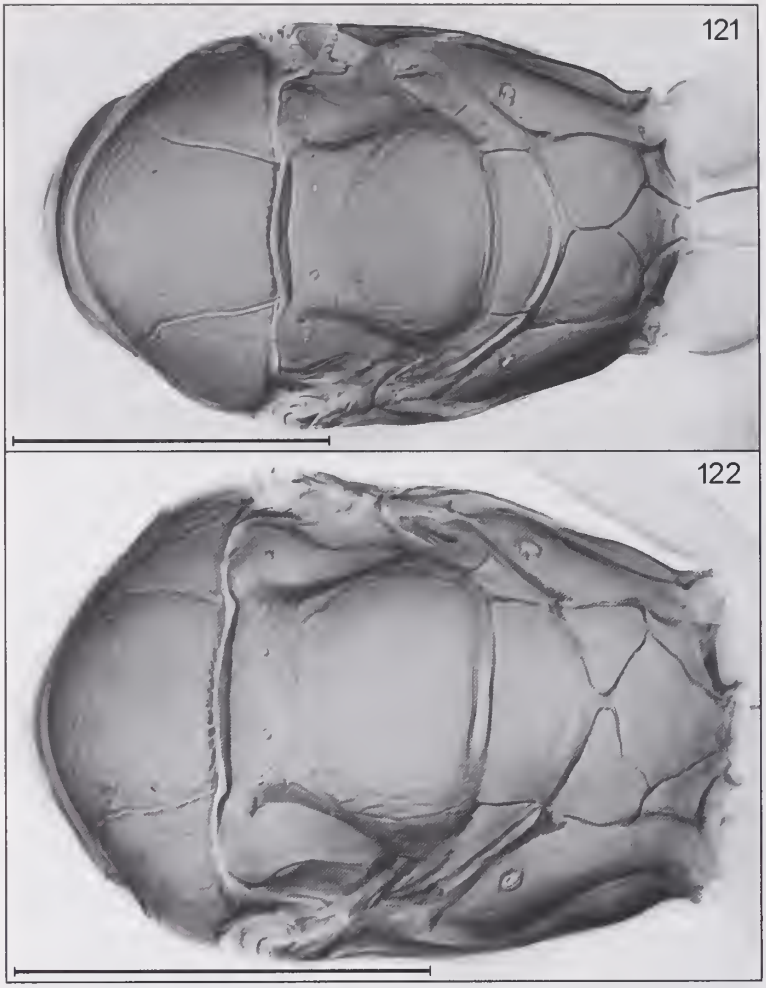
FIGURES 112–114. *Ooctonus* females (except as noted), mesosoma, dorsal view, SEM. 112, *longipetiolus*, male; 113, *notatus*; 114, *occidentalis*, male. Scale bars are 200 μm.



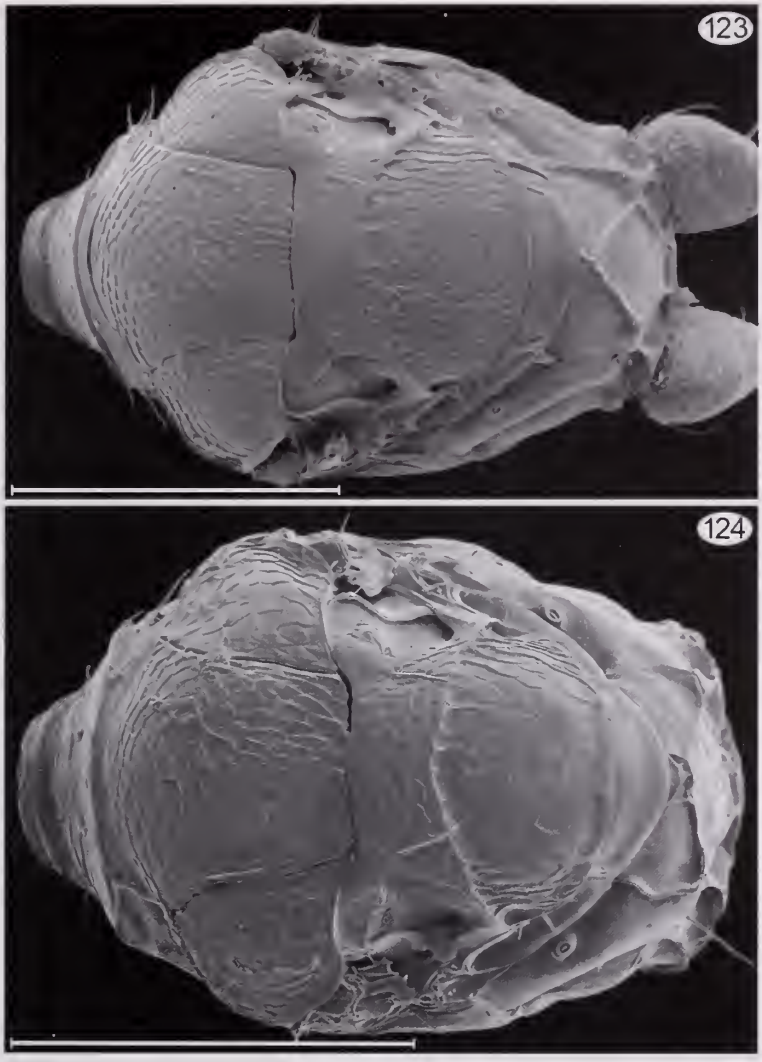
FIGURES 115–117. *Ooctonus* females, mesosoma, dorsal view. 115, *quadricarinatus*; 116, *readae*, holotype; 117, *silvensis*. Scale bars are 200 μm.



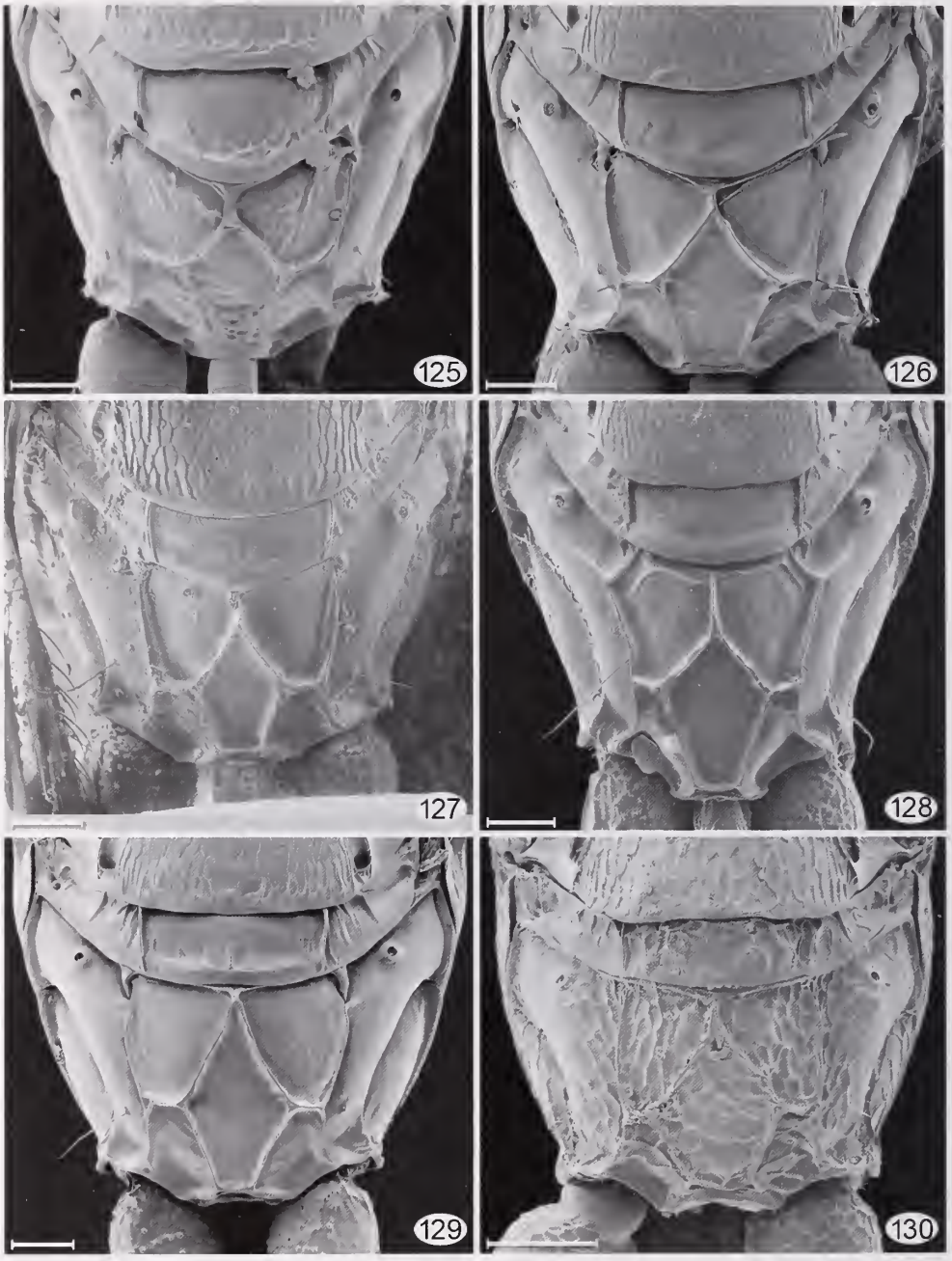
FIGURES 118–120. *Ooctonus* females (except as noted), mesosoma, dorsal view, SEM. 118, *quadricarinatus*, male; 119, *readae*, holotype; 120, *silvensis*. Scale bars are 200 μm.



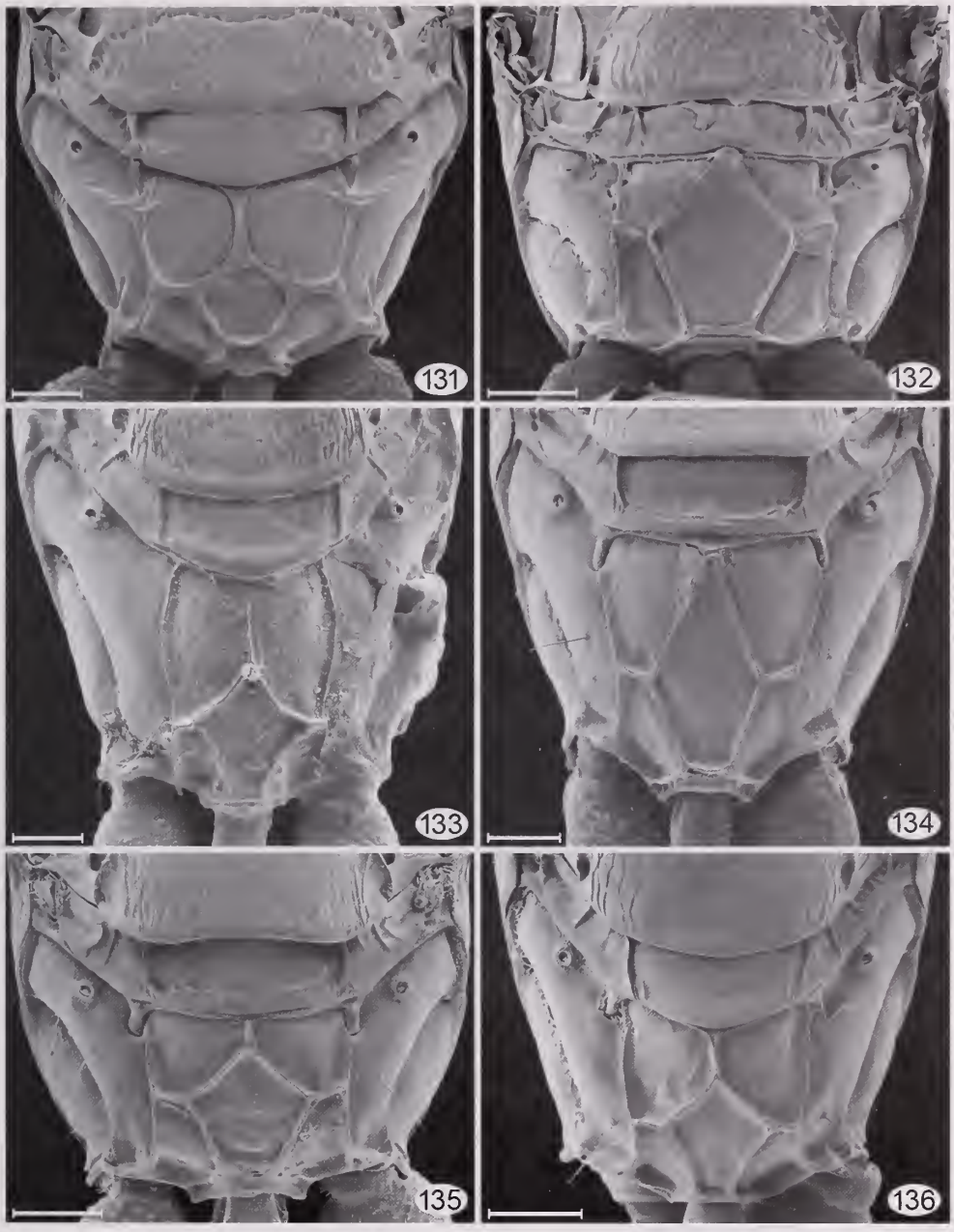
FIGURES 121, 122. *Ooctonus* females, mesosoma, dorsal view. 121, *triapitsyni*; 122, *vulgatus*. Scale bars are 200 μm.



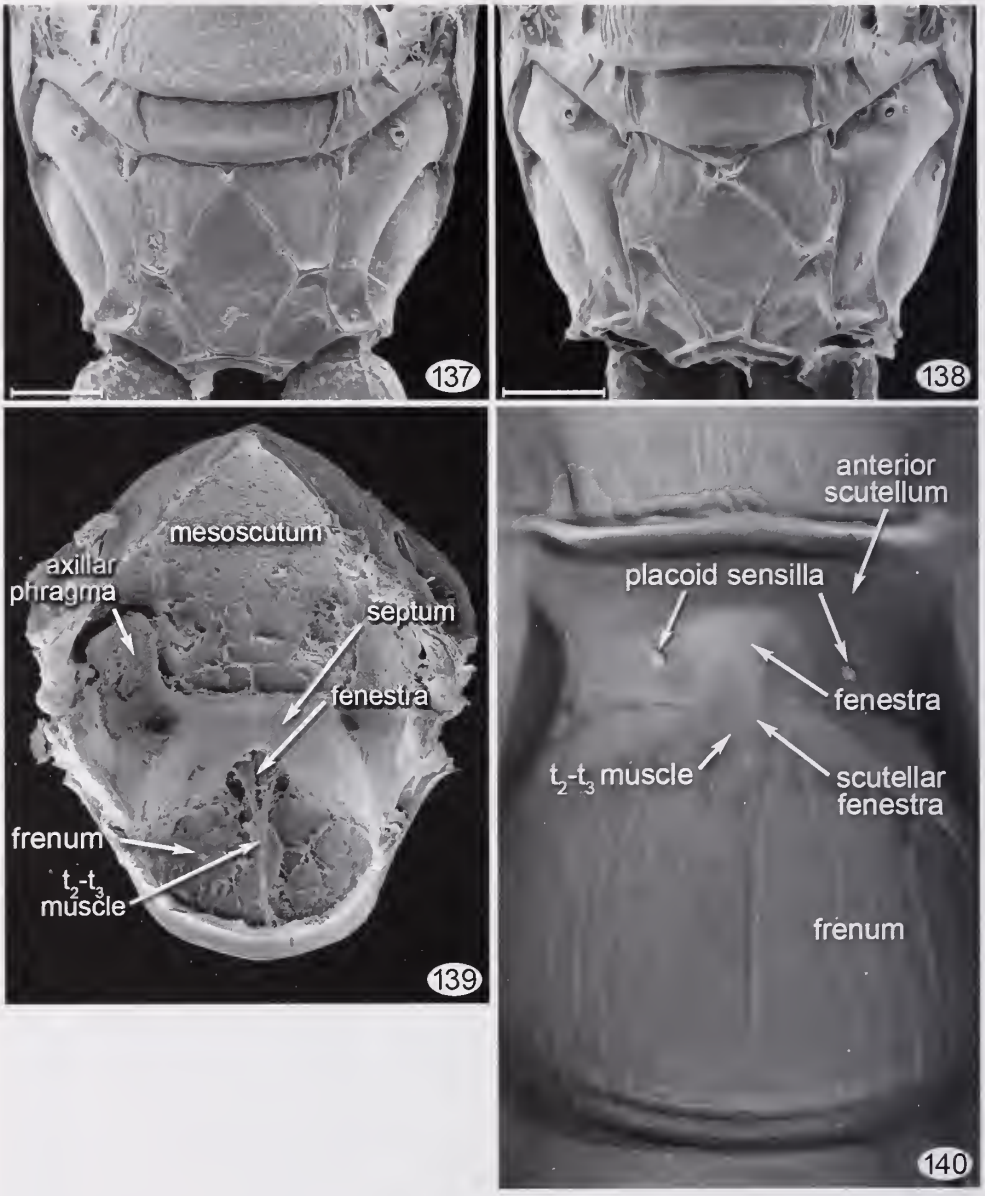
FIGURES 123, 124. *Ooctonus* females, mesosoma, dorsal view, SEM. 123, *triapitsyni*; 124, *vulgatus*. Scale bars are 200 μm.



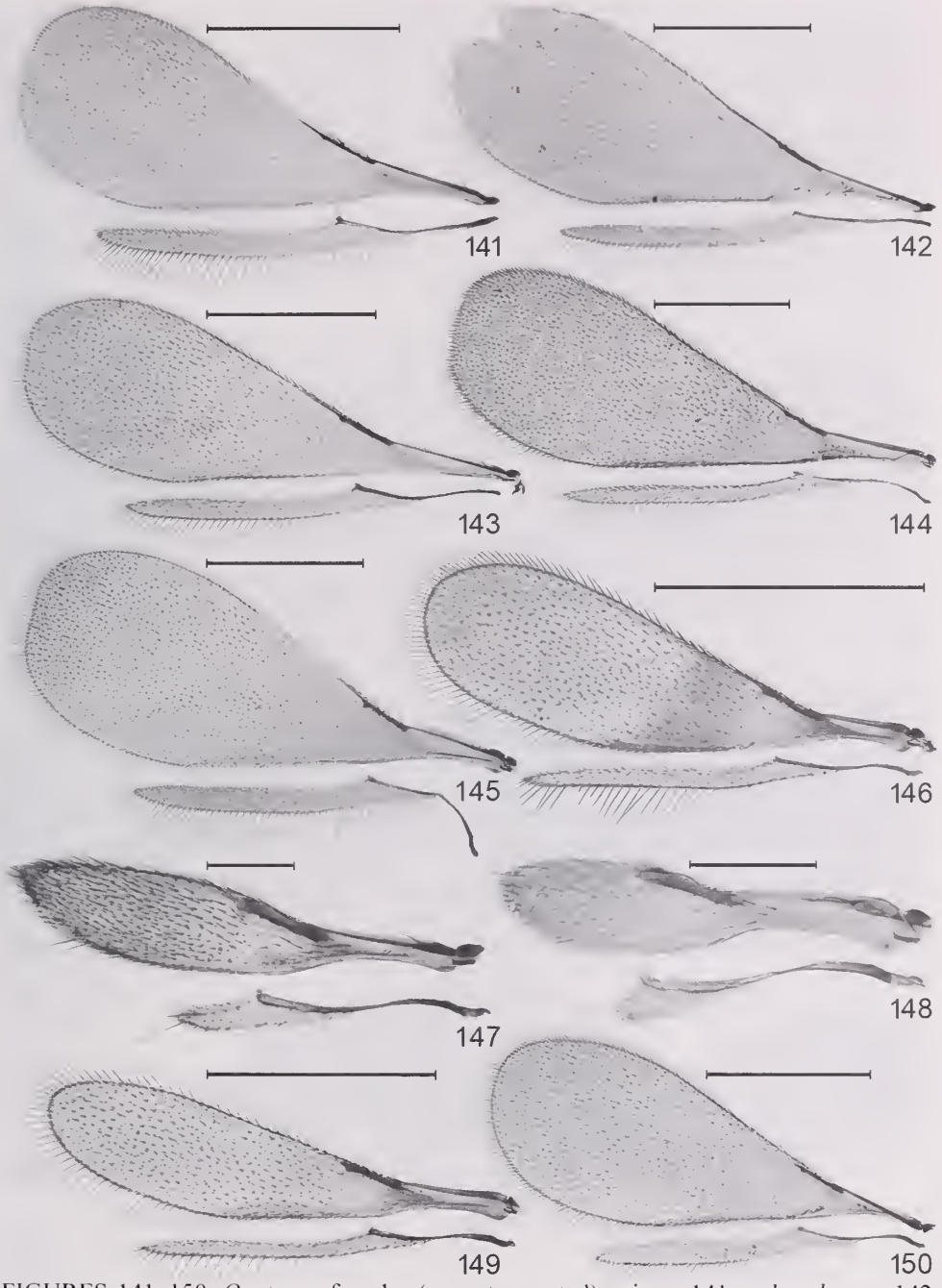
FIGURES 125–130. *Ooctonus* females (except as noted), posterior part of frenum to propodeum, dorsal view, SEM. 125, *aphrophorae*; 126, *arizonensis*; 127, *boltei*; 128, *canadensis*, male; 129, *fuscipes*; 130, *hemipterus*. Scale bars are 50 μm.



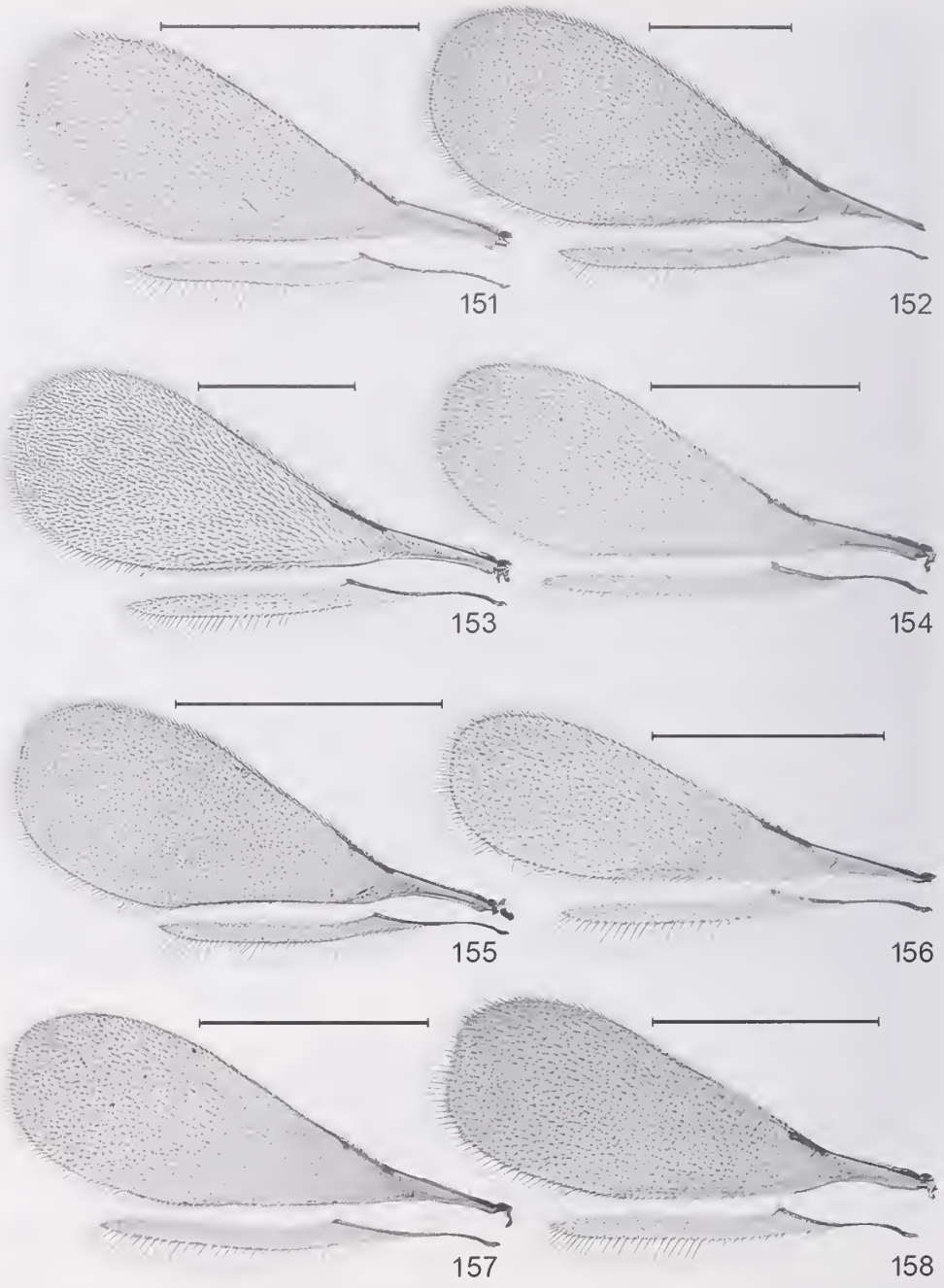
FIGURES 131–136. *Ooctonus* females (except as noted), posterior part of frenum to propodeum, dorsal view, SEM. 131, *longipetiolus*, male; 132, *notatus*; 133, *occidentalis*, male; 134, *quadricarinatus*, male; 135, *readae*; 136, *silvensis*. Scale bars are 50 μm.



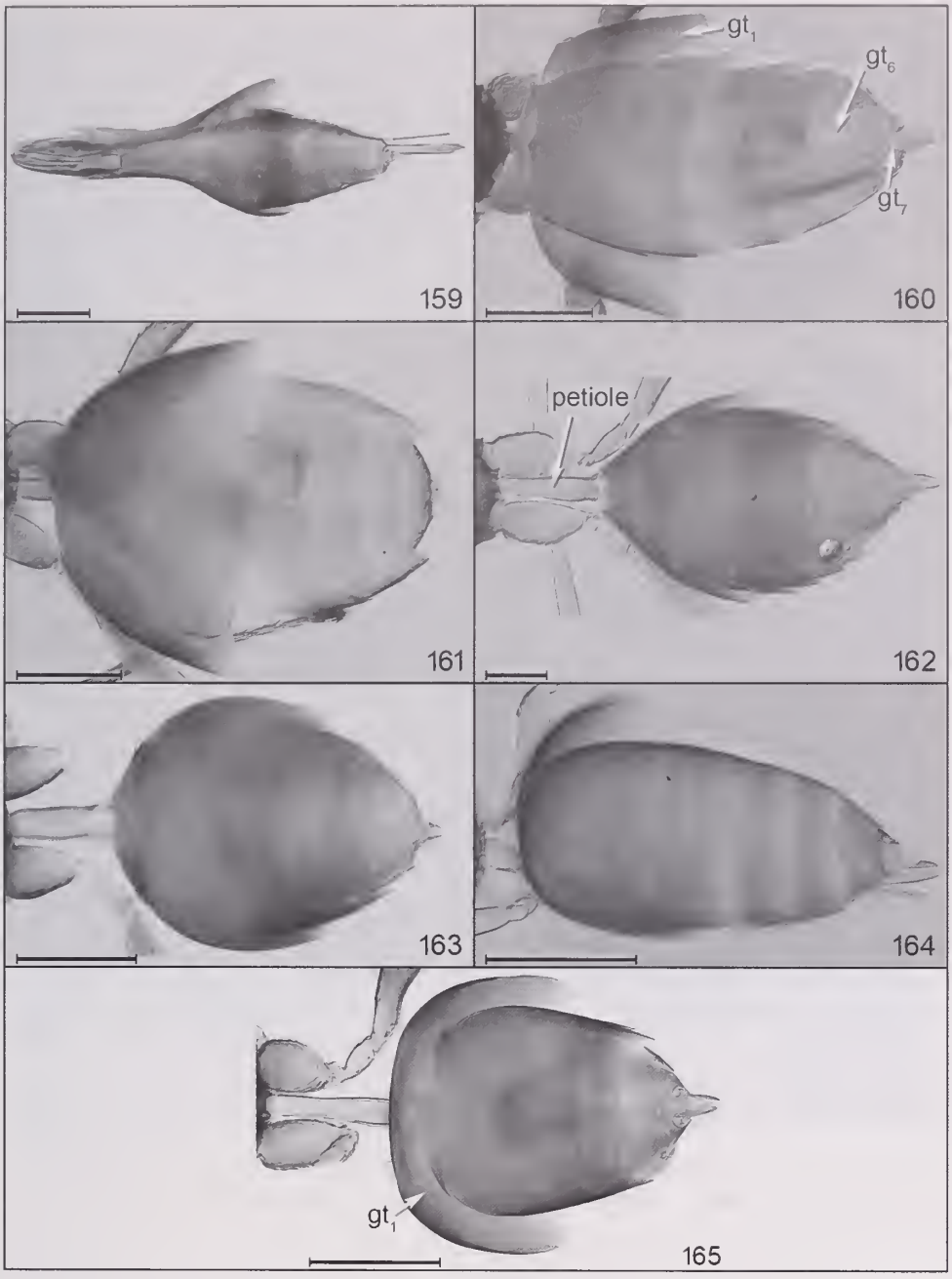
FIGURES 137–140. *Ooctonus* females; 137 and 138, posterior part of frenum to propodeum, dorsal view, SEM. 137, *triapitsyni*; 138, *vulgatus*. 139, dorsum of mesonotum, inside view, SEM. 140, *quadricarinatus*, scutellum (slightly below surface), transmitted light. Scale bars are 50 μm.



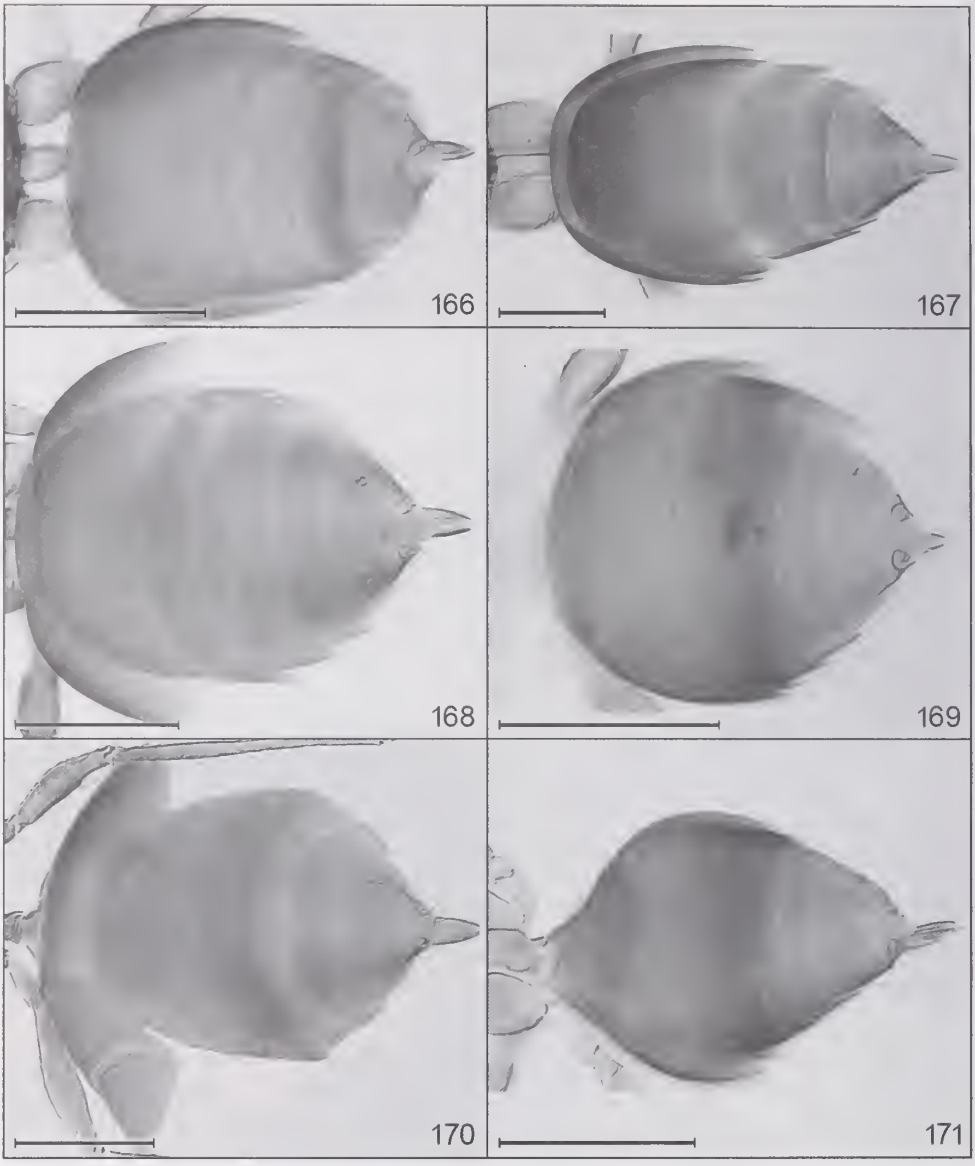
FIGURES 141–150. *Ooctonus* females (except as noted), wings. 141, *aphrophorae*; 142, *arizonensis*, holotype; 143, *boltei*, male; 144, *canadensis*; 145, *fuscipes*; 146, *hemipterus*; 147 and 148, *hemipterus*, short winged forms; 149, *hemipterus*, male; 150, *longipetiolus*. Scale bars are 500 μm except 100 μm for Figures 147 and 148.



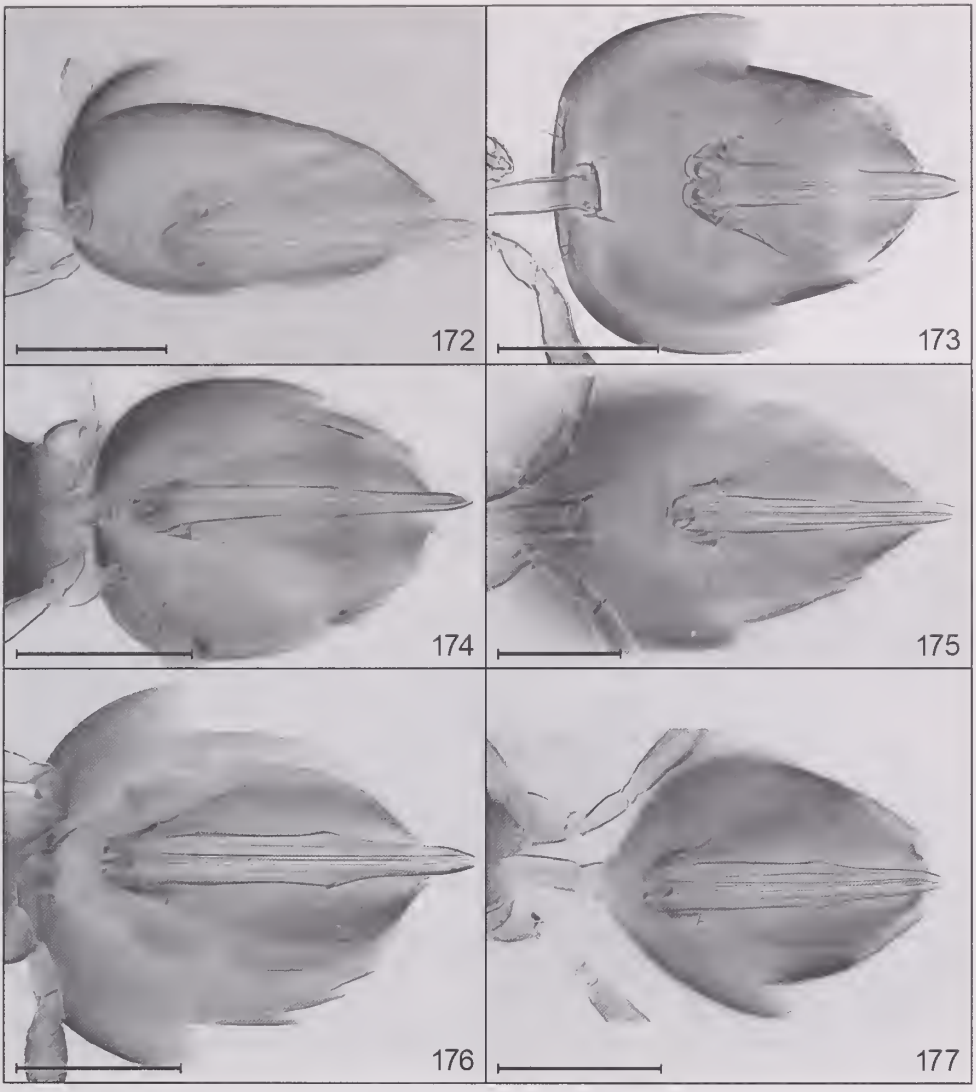
FIGURES 151–158. *Ooctonus* females (except as noted), wings. 151, *notatus*; 152, *occidentalis*; 153, *quadricarinatus*, male; 154, *readae*; 155 and 156, *silvensis*, showing variation; 157, *triapitsyni*, holotype; 158, *vulgatus*. Scale bars are 500 μm.



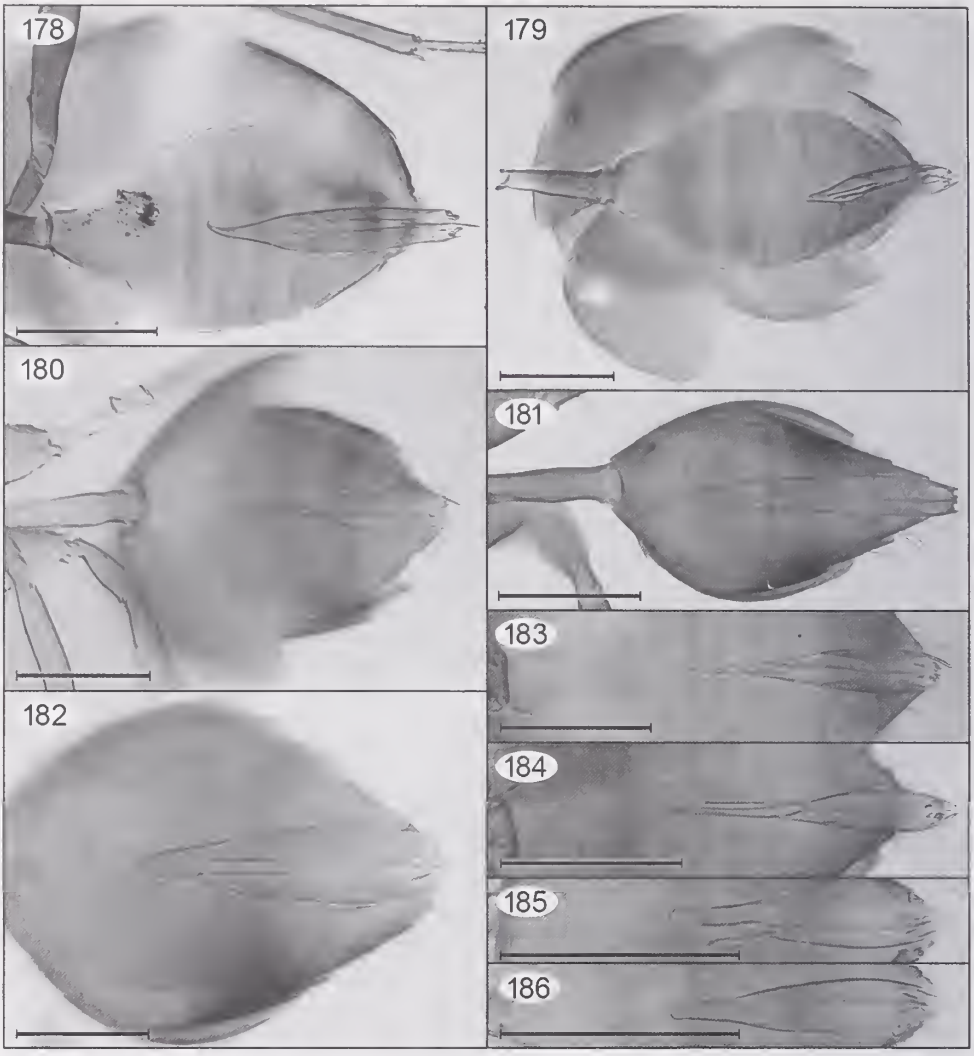
FIGURES 159–165. *Ooctonus* females, petiole + gaster, dorsal view. 159, *aphrophorae*; 160, *arizonensis*, holotype; 161, *boltei*, holotype; 162, *canadensis*; 163, *fuscipes*; 164, *hemipterus*; 165, *longipetiolus*. Scale bars are 200 μm.



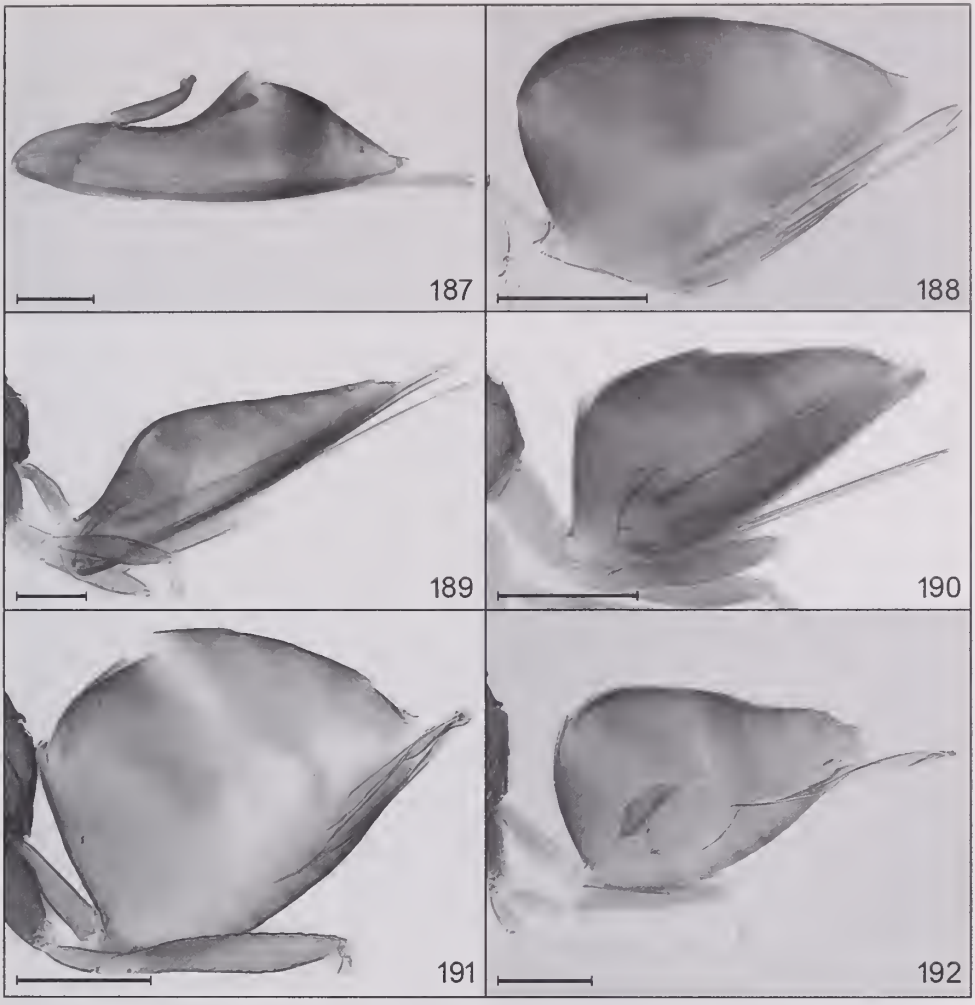
FIGURES 166–171. *Ooctonus* females, petiole + gaster, dorsal view. 166, *notatus*; 167, *occidentalis*; 168, *readae*, holotype; 169, *silvensis*; 170, *triapitsyni*; 171, *vulgatus*. Scale bars are 200 μm.



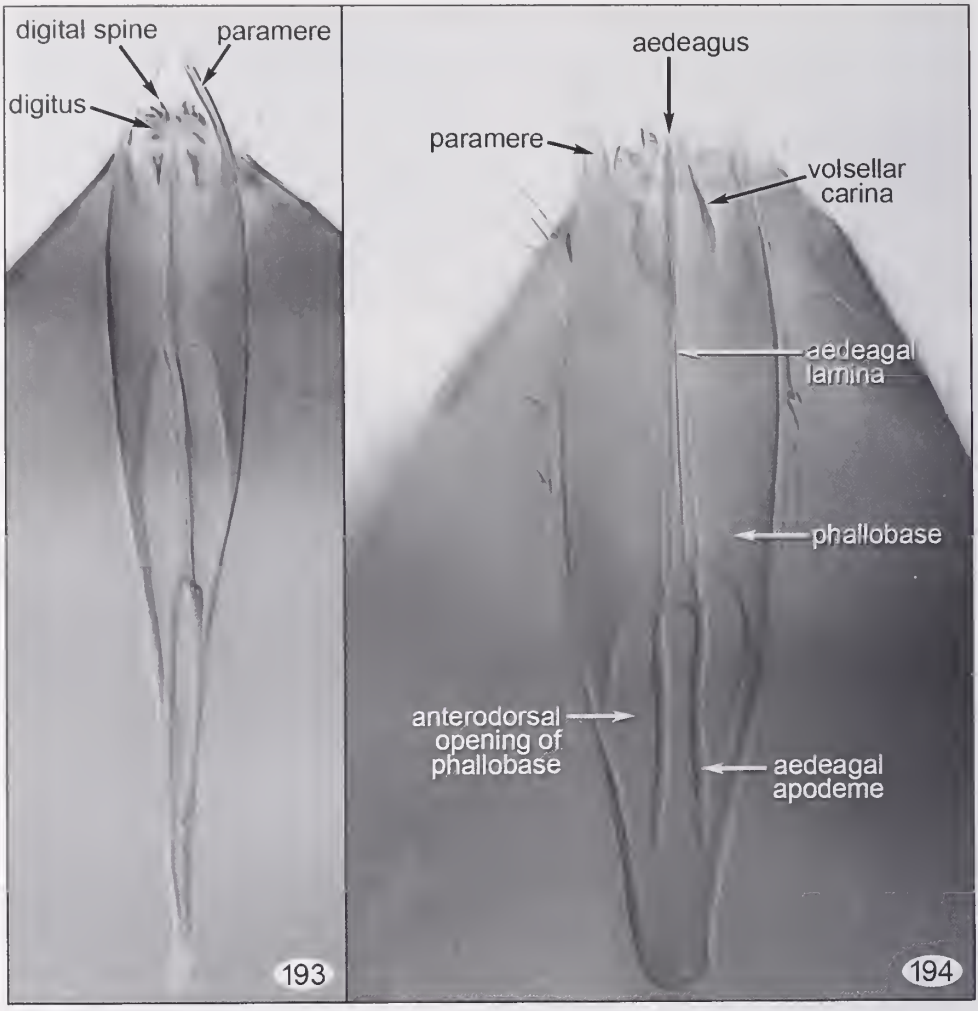
FIGURES 172–177. *Ooctonus* females, petiole + gaster, ventral view. 172, *hemipterus*; 173, *longipetiolus*, holotype; 174, *notatus*; 175, *occidentalis*; 176, *readae*; 177, *silvensis*. Scale bars are 200 μm.



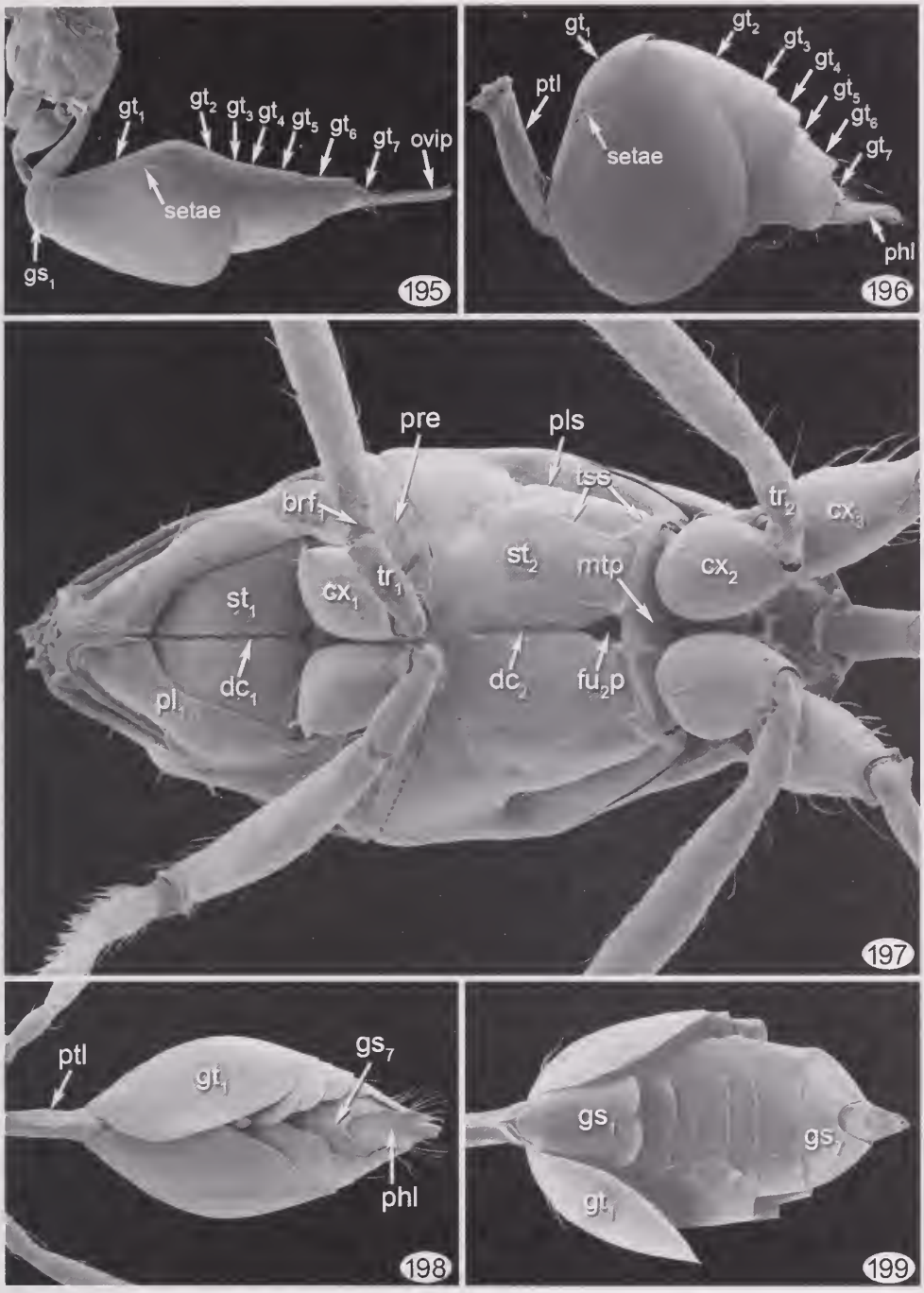
FIGURES 178–186. *Ooctonus* males, gaster and genitalia, ventral view (except as noted). 178, *aphrophorae*; 179, *fuscipes*; 180, *occidentalis*; 181, *quadricarinatus*, dorsal; 182, *silvensis*; 183, *canadensis*, dorsal; 184, *longipetiolus*; 185, *vulgatus*, dorsal; 186, *vulgatus*. Scale bars are 200 μm.



FIGURES 187–192. *Ooctonus* females (except as noted), petiole + gaster, lateral view. 187, *aphrophorae*; 188, *hemipterus*; 189, *quadricarinatus*; 190, *readae*; 191, *aphrophorae*, male; 192, *quadricarinatus*, male. Scale bars are 200 µm.



FIGURES 193, 194. Male genitalia. 193, *canadensis*, dorsal; 194, *silvensis*, ventral.



FIGURES 195–199. *Ooctonus quadricarinatus*, metasoma, except Figures 197 and 199. 195, female, lateral; 196, male, lateral; 197, male, mesosoma, ventral; 198, male, ventral; 199, *Ooctonus* sp., male, ventral. See Table 1 for terms.

FIGURE 200. Neighbour-joining tree based on Kimura-2-Parameter distances for cytochrome c oxidase I.

TABLE 2. CNC barcode and Genbank accession numbers for Nearetic *Ooctonus* species.

***Ooctonus* species**	**CNCHYM#**	**Sex**	**State/Province/Country**	**Genebank Accession #**
arizonensis	07511	♂	Arizona	KC157669
canadensis	07506	♂	California	KC157670
fuscipes	07499	♂	British Columbia	KC157672
	07501	♀	Oregon	KC157673
	07502	♀	Oregon	KC157674
	07503	♀	Oregon	KC157671
hemipterus	07476	♀	Ontario	KC157675
	07477	♂	Quebec	KC157676
	07478	♂	Ontario	KC157677
longipetiolus	07516	♀	Virginia	KC157678
notatus	07459	♀	Ontario	KC157679
	07461	♀	Prince Edward Island	KC157680
	07462	♂	Alberta	KC157681
occidentalis	07504	♂	California	KC157682
	07507	♂	California	KC157683
quadricarinatus	07470	♂	Nova Scotia	KC157684
	07471	♂	Ontario	KC157685
	07472	♂	Nova Scotia	KC157686
	07473	♂	Nova Scotia	KC157687
readae	07464	♀	Ontario	KC157688
silvensis	07491	♀	Florida	KC157689
	07498	♀	Missouri	KC157690
	07496	♂	Oklahoma	KC157691
vulgatus	07484	♀	Ontario	KC157701
	07485	♀	British Columbia	KC157700
	07487	♀	Virginia	KC157699
	07488	♀	Virginia	KC157698
Unassigned				
1	07514	♀	Ontario	KC157695
2	07480	♂	Alberta	KC157697
2	07522	♂	Alberta	KC157696
3	07520	♂	Mexico	KC157694
3	07521	♀	Mexico	KC157693
4	07513	♂	Arizona	KC157692

STATUS OF JUNIPER HAIRSTREAK (*CALLOPHRYS GRYNEUS* HÜBNER) POPULATIONS IN SOUTHWESTERN ONTARIO

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Abstract *J. ent. Soc. Ont.* 144: 107–114

Populations of Juniper Hairstreak (*Callophrys gryneus* [Hübner]) at Point Pelee National Park (PPNP) and Pelee Island have declined over time and are at risk of extirpation. We monitored them in the Red Cedar Savannahs of PPNP from late May–end August and on Pelee Island in early June. Two flights of adults occurred (maximum numbers observed daily in parentheses) from 29 May–12 June (4 at PPNP; 11 at Pelee Island) and 19 July–12 August (10 at PPNP) in and near intermediate-sized (mostly 5-7 m tall) junipers among the upper dunes of a small portion of the point's western shore and in one clearing on Pelee Island. The primary nectar resource used by the first brood was *Ptelea trifoliata* L.; the second brood nectared infrequently on several floral species.

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Introduction

The Juniper or Olive Hairstreak (*Callophrys* (*Mitoura*) *gryneus gryneus* (Hübner [1819]) (hereafter "hairstreak") occurs in eastern Canada along the Frontenac Axis/Napanee Plain of eastern Ontario; in a single site on the Gatineau escarpment in Quebec; and in the western Lake Erie Basin (Layberry et al. 1998). First discovered in southwestern Ontario at Point Pelee in 1882 (Saunders 1885), the population there has declined over time and nearly disappeared between 1976–1984 (Layberry et al. 1998; Wormington 1999). In 1998, their numbers increased dramatically, with a record daily maximum of 139 individuals observed (Wormington 1999), but they have subsequently decreased markedly (Wormington, pers. comm.). On Pelee Island, the species was reported to be extirpated (Layberry et al. 1998), but a modest population was subsequently rediscovered (Hanks and Hess 1992). For the other islands of western Lake Erie, there is a published record of only one individual (Kelleys Island: Nault et al. 1989). The next closest populations are in southern Ohio and western Pennslylvania. Adults occur in two broods each summer, the first beginning in late May and the second in early to mid-July (Wormington, 1998).

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Except when nectaring, Juniper Hairstreaks are almost always observed perched or ovipositing on their larval host plant, the Eastern Red Cedar (*Juniperus virginiana* L.) (henceforth 'cedar'; Douglas and Douglas 2005). Males maintain territories on cedars but are sedentary, making them difficult to detect without disturbing the trees (Iftner et al. 1992; Douglas and Douglas 2005). Although most often reported in open stands of cedar 5–8 m tall (Iftner et al. 1992), *C. gryneus*, when abundant, can also be found on lone cedars (Glassberg, 1999). The species has been reported to have disappeared from some sites that have become overgrown or in which cedars have grown too large (Layberry et al. 1998).

Point Pelee National Park (PPNP) is located on the tip of a narrow peninsula that extends southward into Lake Erie and contains Lake Erie Sand Spit Savannah habitat that is exceptionally rare in Canada, existing only at PPNP, Rondeau Provincial Park, Long Point, and Pelee Island (Dougan and Associates 2006). Numerous rare plant and animal species are isolated on Point Pelee by water on two sides and by extensive farmland to the north (McLachlan and Bazely 2002). In PPNP, *C. gryneus* has historically been found in the savannah habitat that exists along the point's western shore (Layberry and Jones 2008; O'Neill, pers. comm.; Wormington, pers. comm.; C. Jones, pers. comm.). Its scarcity at Point Pelee and on the Lake Erie Islands coupled with its isolation from other populations renders it potentially at risk. PPNP personnel are considering the use of an ecosystem-based approach to conserve *C. gryneus* and the rare habitat in which it lives (Dougan and Associates 2007). A few patches of upper beach have already been cleared to improve habitat for *C. gryneus* and several other endangered species. The Nature Conservancy of Canada has begun habitat restoration on Pelee Island, including the planting of cedars, with the stated goal of increasing the *C. gryneus* population there (Nature Conservancy of Canada 2008). Because knowledge of the population size of *C. gryneus* and its habitat requirements is integral to future management initiatives, we monitored and observed Juniper Hairstreaks in the cedar savannah of PPNP from late May–end August, and on Pelee Island in early June, 2011.

Methods

Because *C. gryneus* is seldom observed far from host plants, PPNP reports (Dougan and Associates 2007) and staff were consulted in order to determine the distribution of cedars within the park. We focused on the three areas where cedars are abundant and the habitat may be suitable for this species: clearings along the entire West Beach Footpath, the small garden area north of the PPNP Visitors' Centre, and clearings at the north end of the DeLaurier Homestead Trail. We performed surveys from 11:00–16:00h on days when the temperature was ≥17° C and there was no precipitation, climatic criteria consistent with published butterfly survey techniques (Pollard 1977; Wikstrom et al. 2009).

We conducted surveys every few days, from 25 May –26 June, 2011, for the first brood, and from 19 July–19 August, 2011, for the second brood. We stopped surveying only after failing to record hairstreaks on three consecutive surveys. Initially, in order to limit disturbance to the sensitive habitat, we shook all cedars (as described below) within 2.5 m of established trails. Upon encountering the first hairstreak of each flight period, we conducted more intensive surveys both on- and off-trails, during which we disturbed every

cedar tree by grasping and moving small trees or tapping and shaking taller trees with a stick at a height of 3.75 m. All flowers within clearings were inspected as well. This was performed along the West Beach Trail south of the PPNP Visitors' Centre (29, 30 May; 2, 8, 9, 12, 15, 18, 20, 24, 25 June; 9, 19, 22, 23, 31 July; 1, 4, 6, 12, 17, 18, 19 Aug.); West Beach Trail north of the PPNP Visitor's Centre (29 May; 15, 17, 25, 26 June; 1, 3, 5, 15 Aug.); in front of the PPNP Visitor's Centre (1, 8, 9, 20, 25 June; 9, 23 July; 4, 17, 19 Aug.); and along the DeLaurier Trail (1, 8, 14, 22 June; 3, 11 Aug.). Despite reports that the hairstreaks prefer small to medium-sized cedars (Layberry et al. 1998), we inspected cedars of all sizes to prevent bias in our survey.

For each hairstreak observed, we recorded GPS coordinates, habitat characteristics (cedar height, nearby flowering plant species, and estimates of vegetation density), and butterfly behaviour (flight height and pattern, perching, feeding behaviour, and oviposition).

Between 4–6 June, 2011, two observers surveyed at least once all sites on Pelee Island with sizeable Red Cedar populations. Five sites suggested to us by John Ambrose (pers. comm.) included the locations where hairstreaks have been seen in recent history (C. Jones, pers. comm.). Their coordinates are: N41.750° W82.647°, N41.757° W82.677°, N41.752° W82.631°, N41.809° W82.644° and N41.761° W082.645°.

Results

At PPNP, from 29 May–12 June, we had 9 sightings of hairstreaks of the first brood, with a daily maximum of 4 individuals recorded on 12 June. Individuals of the second brood were observed from 19 July–12 August (45 individuals; maximum daily count of 10 recorded on 4 August). All sightings were along the West Beach Footpath, from the trailhead west of the PPNP Visitors' Centre south to the end of the Tip Road. We observed no hairstreaks elsewhere, although one was reported outside the PPNP Visitors' Centre on 5 Aug. by park naturalist J. Brownlie. The sites occupied by hairstreaks were generally open sandy areas with grasses up to 0.5 m high, numerous cedars and many Common Hoptrees (*Ptelea trifoliata* L.). These clearings were either sheltered from the beach by vegetation or the hairstreaks were ≥30 m from Lake Erie.

Five hairstreaks of the first brood were observed feeding on the blossoms of Common Hoptree. They generally walked along branches from one inflorescence to another rather than flying between them. Other flowering plant species at this time were scarce, the most common being Hoary Puccoon (*Lithospermum canescens* (Michx.) Lehm.). The remaining 4 hairstreaks were perched 2–6 m above ground on mid-sized cedars (6–7.5 m tall). Most were sedentary until disturbed, at which point they made short flights to nearby trees or back to the original branch. Flights were weak and erratic, with many directional changes.

Forty-two of the 45 hairstreaks of the second brood that we observed were on cedars. Most were perched 5-7 m above the ground. Flight behavior was consistent with hairstreaks of the first brood. Two females were observed ovipositing at a height of ~3 m on 6–7.5 m tall cedars. Twenty-five observations were in a single clearing (Figure 1). Only three second-brood individuals were observed feeding, all on non-native species: Bouncing Bet

FIGURE 1. Clearing typical of habitat along West Beach Footpath where Juniper Hairstreaks were found. This particular clearing was the location of 25 (56%) of all second brood sightings.

(*Saponaria officinalis* L.), Queen Anne's Lace (*Daucus carota* L.), and White Sweet Clover (*Melilotus alba* Medik.). Despite extending its proboscis, the individual on *Saponaria* may not have successfully fed due to the long corolla length of the flower. Spotted Knapweed (*Centaurea maculosa* Lam.), a very common invasive species, was in bloom close to all observed hairstreaks, but we saw none feeding upon it. Other plants in flower nearby were Common Mullein (*Verbascum thapsus* L.), Rough-Fruited Cinquefoil (*Potentilla recta* L.), Staghorn Sumac (*Rhus typhina* L.), Wild Bergamot (*Monarda fistulosa* L.), and the endangered Eastern Prickly Pear Cactus (*Opuntia humifusa* (Raf.) Raf.).

During the Pelee Island surveys on 4–6 June, we encountered 9, 10, and 11 hairstreaks on 4, 5, and 6 June, respectively. All were sighted in a single sheltered clearing with scattered cedars in a forested part of the Richard and Beryl Ivey Conservation Area (N 41.757 W 082.677). As at PPNP, these hairstreaks were predominantly on Common Hoptree flowers, but one was observed feeding on Raspberry (*Rubus idaeus* L.) flowers. At times up to three were observed feeding on a single Common Hoptree inflorescence (Figure 2). Other flowers nearby included Hairy Beardtongue (*Penstemon hirsutus* L.) and Eastern Red Columbine (*Aquilegia canadensis* L.).

FIGURE 2. Two Juniper Hairstreaks feeding on Common Hoptree flowers.

Discussion

The *C. gryneus* populations we observed at PPNP and on Pelee Island were small. We did observe more individuals than have been reported in recent years (Layberry and Jones, 2009; C. Jones, pers. comm.); this may reflect in part our intensive surveying methods. The first brood of hairstreaks at PPNP is reported to be usually larger than the second (Wormington, pers. comm.) but this was not the case in 2011. The late spring and frequent rain in June may have negatively affected the size of the first brood or positively affected the numbers in the second brood. From our observations, Common Hoptree flowers were the primary nectar source for the first brood of *C. gryneus* both at PPNP and on Pelee Island, either by preference or from lack of suitable alternatives.

The absence of hairstreaks along the West Beach Trail north of the Visitors' Centre was likely due to the overgrowth of trees and shrubs (Figure 3), causing extensive shade and a low abundance of nectar sources (e.g., Common Hoptrees were absent). Sections of this path that were not overgrown were often quite exposed and beach-like, with no shelter from the lake and with fewer, often large (≥12 m tall) cedars that were likely too large to be suitable for oviposition (Layberry et al. 1998).

FIGURE 3. Overgrown Red Cedar Savannah typical of West Beach Footpath north of the Point Pelee Visitors' Centre, with a Red Cedar tree visible in the center of the photo. No Juniper Hairstreaks were observed in this habitat.

The clearings at the northern portion of DeLaurier Homestead Trail appeared very similar to sites where we observed hairstreaks except that Common Hoptrees were scarce. The absence of a suitable nectar source for the first brood may have contributed to the hairstreaks' absence from this otherwise apparently suitable habitat. Individuals of the second brood were infrequently observed feeding on only three species of flowers despite many other species being present. The lack of hairstreaks feeding on Spotted Knapweed was striking, particularly since Alan Wormington (pers. comm.) has observed *C. gryneus* nectaring on it in other years.

Unfortunately, we could not mark the hairstreaks due to the fragility of these small butterflies and concerns that we might harm them and further reduce their populations. However, because of our intensive search method for hairstreaks both on cedars and on flowers, their sedentary nature, and their tendency to return to the same site after disturbance, we are confident that we observed a high proportion of the hairstreaks that were present at both Point Pelee and Pelee Island. It is therefore likely that the populations at both sites consisted of less than 100 individuals. This is well below the effective population size that is generally considered critical for a population to maintain sufficient genetic variation for adaptive evolution to occur (Lynch and Lande 1998). Therefore, the efforts to open up overgrown cedar stands, as have already begun by the staff at PPNP and the NCC, and increasing the number of appropriate adult nectar sources would seem to be suitable first steps to hairstreak population recovery at PPNP and Pelee Island. The status of the Juniper Hairstreak on the other Lake Erie Islands is unknown: the only reports have been of three

individuals from Kelleys Island, in 1988 (Nault et al.1989), ~2000 (B. Coleman, pers. comm.), and as recently as 2010 (D. Horn, pers. comm).

The geographic isolation of the Lake Erie Basin metapopulation from other populations of Juniper Hairstreaks prompts questions regarding its genetic distinctness. It would be interesting to know the degree of genetic dissimilarity with *C. gryneus* from the three closest populations: Napance, Ontario (~500 km to the east), southern Ohio/west-central Indiana (~260-400 km to the south and southwest), and western Pennsylvania (~300 km to the southeast). This species should be surveyed in other Red Cedar Savannah habitats at Rondeau Provincial Park, Long Point, and the Lake Erie Islands of Ohio.

Acknowledgements

We are grateful to Alan Wormington for sharing his vast knowledge of the butterflies of Point Pelee. Thanks also go to Henrietta O'Neill for her advice regarding our surveys. Timothy J. Brown assisted with fieldwork on Pelee Island. Colin Jones compiled data regarding Juniper Hairstreaks from records of the Toronto Entomologists' Association. Barb Coleman, Cleveland Museum of Natural History and Dave Horn shared their observations from Kelleys Island. Mhairi McFarlane and the staff of the Nature Conservancy of Canada granted us use of the Ivey Research Station on Pelee Island. John Ambrose shared his extensive knowledge of the flora of Pelee Island. The entire staff of PPNP was supportive and shared their knowledge throughout the entire project. Comments of Peter Hall, an anonymous reviewer, and the journal editor greatly improved this manuscript.

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LARVAL PARASITOIDS OF THE CABBAGE LOOPER, *TRICHOPLUSIA NI* (LEPIDOPTERA: NOCTUIDAE), IN FIELD TOMATO CROPS IN SOUTHWESTERN ONTARIO

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The Cabbage Looper, *Trichoplusia ni* Hübner (Lepidoptera: Noctuidae) is a cosmopolitan insect pest that causes damage in more than 160 species of plants (Sutherland and Greene 1984), and has become a chronic pest of Canadian greenhouse vegetable crops (Gillespie et al. 2002). Each spring, the overwintering population of *T. ni* migrates north from the southern United States to establish seasonal populations in Canada (Lafontaine and Poole 1991). In commercial indoor settings, growers rely on Btk (*Bacillus thuringiensis* var. *kurstaki*) products to manage outbreaks of *T. ni*. Outdoors, growers rely on chemical pesticides. Btk appears to be compatible with natural enemies and insect pollinators although the recent development of *T. ni* resistance to Btk is a major concern in the vegetable industry (Janmaat and Myers 2003) and new and effective natural enemies are needed. The objective of this study was to determine the native parasitoid assemblage of larval stages of *T. ni* in tomato fields in southwestern Ontario for the selection of potential biological control agents.

A survey for larval parasitoids of *T. ni* was conducted on field tomato (*Solanum lycopersicum* Mill.) (Solanaceae) crops in 2005 and 2006 in Essex County, Ontario. Three 2000-plant plots of commercial processing tomato were planted with the varieties Heinz Q909, TH4, and an experimental hybrid in 2005. In 2006, Heinz 9478 was used in all three plots. Plots were located on three different farms separated by about 5 km from each other. One hundred tomato plants per plot were sampled weekly beginning on May 20 in 2005 and on June 13 in 2006. Larvae collected from the survey were reared individually on a pinto bean diet (Shorey and Hale 1965) in a growth chamber at 24°C, with a 12:12 photoperiod and 60% RH until emergence of parasitoids or an adult *T. ni* moth. The number of parasitised larvae of each instar of *T. ni* by each parasitoid was recorded and compared using Chi-Square tests.

Nine species of primary parasitoids (eight Hymenoptera and one unidentified Diptera–Tachinidae) were reared from larval stages of *T. ni*, but only 7 of them within each of the two years (Table 1) and one hyperparasitoid, *Trichomalopsis viridescens* (Walsh)

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TABLE 1. Number and parasitism rates of larval parasitoids of *Trichoplusia ni* in southwestern Ontario tomato fields.

Year	Date	Larvae (#)	*Campoletis sonorensis* (Ichneumonidae)	*Euplectrus sp.* (Eulophidae)	*Cotesia marginiventris* (Braconidae)	*Microplitis alaskensis* (Braconidae)	*Copidosoma floridanum* (Encyrtidae)	*Cotesia plathypenae* (Braconidae)	Unidentified Braconidae	*Meteorus* sp. (Braconidae)	Unidentified Tachinidae
2005	06-Jul	47	13	0	1	0	0	0	0	0	0
	15-Jul	33	6	1	0	0	0	0	0	0	0
	23-Jul	40	4	0	0	0	1	0	0	0	0
	28-Jul	59	14	0	0	0	1	1	0	0	0
	03-Aug	81	19	0	0	0	2	0	0	0	0
	10-Aug	69	12	1	0	0	0	0	0	0	0
	24-Aug	61	3	1	0	1	0	0	1	0	0
	02-Sep	36	4	0	0	0	0	0	0	0	0
	Total (#)	426	75	3	0.9	1	4	1	1	0	0
	Parasitism(%)		17.6	0.7	0.2	0.2	1.0	0.2	0.2	0	0
2006	20-Jul	16	7	0	0	0	0	0	0	0	0
	27-Jul	7	1	0	0	0	1	0	0	0	0
	02-Aug	28	9	0	0	0	1	0	0	0	0
	09-Aug	40	19	0	2	0	1	0	0	0	0
	17-Aug	72	32	0	0	0	0	0	0	0	0
	24-Aug	71	38	1	0	2	0	0	0	1	0
	29-Aug	139	54	0	3	0	0	0	0	2	0
	08-Sep	67	27	2	1	0	0	0	0	1	0
	15-Sep	57	8	0	0	0	0	0	0	0	3
	Total (#)	497	195	3	6	2	3	0	0	4	3
	Parasitism(%)		39.2	0.6	1.2	0.4	0.6	0.0	0.0	0.8	0.6

(Hymenoptera: Pteromalidae), was reared from *Campoletis sonorensis* (Cameron). Although Braconidae had the higher number of species, Ichneumonidae had the greatest parasitism rates due to dominance of the solitary larval endoparasitoid *C. sonorensis* (Table 1), which was found parasitising *T. ni* larvae from the collection date of *T. ni* larvae within each year. Other larval parasitoids were rarely found (Table 1). From 400 *T. ni* larvae in 2005 and 365 in 2006 for which we determined the instar at collection, the 2nd instar of *T. ni* was the larval stage with the highest parasitism rates by *C. sonorensis* and by all the other parasitoid species as well (Table 2). The number of parasitised 2nd instars differed significantly from all other parasitised instars combined in both years (2005: $X^2_{1,1} = 43.422$, $P < 0.001$; 2006: $X^2_{1,1} = 59.038$, $P < 0.001$).

In North America, *Copidosoma floridanum* (Ashmead) and *Cotesia marginiventris* (Cresson) are reported as common parasitoids of *T. ni* (Marston et al. 1984; Martin et al. 1984; Godin and Boivin 1998; Waterhouse 1998; Shelton et al. 2002; Wold-Burkness et al. 2005), *C. sonorensis* and *Microplitis alaskensis* (Ashmead) have rarely been collected from *T. ni* (Martin et al. 1984; Waterhouse 1998), *Cotesia plathypenae* (Muesebeck) is a new record for *T. ni*, and *Euplectrus* species are commonly reported but *Meteorus* species are not (Marston et al. 1984; Martin et al. 1984; Waterhouse 1998; Wold-Burkness et al. 2005). The hyperparasitoid *T. viridescens* is associated with several braconid and ichneumonid parasitoids attacking Noctuidae (Lepidoptera) (Gibson and Floate 2001) but our work seems to be the first report on *C. sonorensis* and *T. ni*.

Campoletis sonorensis has been well studied for control of *Helicoverpa* species and *Spodoptera frugiperda* (J.E. Smith) in corn and cotton crops (Lingren 1977; Isenhour 1986) but has been reported on *T. ni* only once in southern California in lettuce (*Lactuca sativa* L., Asteraceae) (Henneberry et al. 1991) and once (as *C. websteri*) in Texas (crop host not reported) (Carlson 1972; Harding 1976). We believe *C. sonorensis* should be evaluated as a biological control agent for *T. ni* in field and greenhouse crops in southwestern Ontario due to its high natural abundance and synchrony with *T. ni* populations (Murillo et al. 2009).

TABLE 2. Overall total percent parasitism of *Trichoplusia ni* larval instars. Numbers in bold indicate significantly higher parasitism rates as compared to other instars (Chi-Square test, $P > 0.05$).

Year	2005			2006		
Instar	Larvae (#)	*Campoletis sonorensis* (%)	All other parasitoids (%)	Larvae (#)	*Campoletis sonorensis* (%)	All other parasitoids (%)
1	41	0.0	0.0	7	0.0	0.0
2	210	22.9	3.8	177	31.6	8.5
3	118	2.5	1.7	84	8.3	4.8
4	24	0.0	0.0	54	0.0	1.9
5	7	0.0	0.0	43	0.0	0.0
Total	400	12.75	2.5	365	17.3	5.5

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FIRST NEARCTIC RECORD OF *CAMILLA ATRIMANA* (DIPTERA: CAMILLIDAE)

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Scientific Note *J. ent. Soc. Ont.* 143: 121–124

Members of Camillidae are among the least known Diptera in the Nearctic Region. Worldwide, this small family consists of four extant genera and approximately 40 species (Pape et al. 2011). Most species occur in the Palearctic and Afrotropical regions, and the family was not recorded in the New World until McAlpine (1960) noted the occurrence of *Camilla glabra* (Fallen) in Ottawa, Ontario. *Camilla glabra* is a widespread Palearctic species and its occurrence in the New World presumably represents an accidental introduction. The family was included in McAlpine (1987) on the basis of this population. Barraclough and Wheeler (1995) later described two endemic species of *Afrocamilla* Barraclough from Arizona and California and one of *Camilla* Haliday from Baja California, and Barraclough and Fitzgerald (2001) described an additional species of *Afrocamilla* from Colorado. Barraclough and Wheeler (1995) examined the status of *C. glabra* , noting that specimens were only collected in a small area of Ottawa between 1954 and 1965 and suggesting that this population is likely extirpated. Thus the current known Nearctic fauna of Camillidae consists of three species of *Afrocamilla* and one of *Camilla*. Here we record and key an additional species of *Camilla* in the Nearctic region.

The specimens of *Camilla atrimana* Strobl reported here were collected with a Vortis suction sampler (Burkard Manufacturing Co. Ltd., Hertfordshire, UK) during an invertebrate survey of experimental grass plots at the Guelph Turfgrass Institute. They are deposited in the University of Guelph Insect Collection, Guelph, ON (DEBU); we also examined material from the Canadian National Collection of Insects, Arachnids & Nematodes, Ottawa, ON (CNCI).

Key to Nearctic *Camilla* species

1 Scutum mostly shining. Wing apex rounded. Legs yellow. 2
– Scutum covered with microtomentum. Wing apex distinctly pointed. Femora 1–3 and tibia 1 black, tibiae 2 and 3 brown (Fig. 1)..... ..... *C. atrimana* (Ontario, adventive)

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2 About 7 genal bristles subequal to vibrissal length. Tegite 2 without enlarged median bristles..... .....*C. glabra* (Ontario, adventive; Nearctic population probably extirpated)

– One genal bristle subequal to vibrissal length. Tergite 2 with medial pair of bristles enlarged..... *C. arnaudi* (Baja California)

***Camilla atrimana* Strobl**

Camilla glabra var. *atrimana* Strobl 1910

Camilla atripes Duda 1934

Camilla atrimana: Papp 1985 (key, illustration)

FIGURE 1. Lateral habitus of female *Camilla atrimana* from Guelph, Ontario.

Material examined. **Canada:** ON: Guelph, Guelph Turfgrass Institute, 43°32′56″N 80°13′06″W, June 2010, J. Holdenried (2 ♂ 19♀, DEBU). **Germany:** Ingelheim am Rhein, Malaise trap, July 1965 (2 ♂ 4 ♀, CNCI). **Great Britain:** Devon: Paignton, 6 June 1960, J.R. Vockeroth (2 ♂, CNCI), same but 23 August 1960 (1 ♂, CNCI); Devon: Clennon Valley, Paignton, 23 August 960 (1 ♀, CNCI), same but 26 August 1960 (1 ♂ 2 ♀, CNCI); Devon: Torquay, 25 June 1960, J.R. Vockeroth (1 ♂, CNCI); Devon: Berry Head, Brixham, 1 September 1960 (1 ♀, CNCI).

Members of the family Camillidae can be separated from other Nearctic Diptera based on a combination of characters: one proclinate and one reclinate orbital bristle, arista with long dorsal rays and very short ventral rays, an episternum with at least one strong bristle, fore femur with anteroventral spines, mid tibia with preapical dorsal bristle, cell cu*p* not developed, and cells bm and dm confluent. Species of camillids are most similar to those of Drosophilidae and Diastatidae, which also have proclinate and reclinate orbital bristles and often a plumose arista; however, species in both these families lack a strong anepisternal bristle, have two reclinate orbital bristles and a complete cell cu*p*, and usually have the arista with dorsal and ventral rays of similar size. *Camilla atrimana* is a typical member of the genus, based on the plumose arista, two dorsocentral bristles, clear wing, and abdominal tergite 2 not bulging posteriorly. There is no single key to all the species of *Camilla*, but Papp (1985) covers all Palearctic members of the genus. The three African species can be excluded as they lack the preapical dorsal bristle on the mid tibia and anteroventral spine on the fore femur (Barraclough 1993). The newly collected Guelph specimens externally match the descriptions and available European material of *C. atrimana*, and the genitalia of a dissected male match illustrations of this species provided by Papp (1982).

In general, camillid specimens are rarely collected. Three of the Nearctic species are known from single specimens (Barraclough and Wheeler 1995), and the Afrotropical diversity was almost entirely unknown until collectors began to focus on rock hyrax, *Procavia capensis* (Pallas), latrines and bat guano in caves (Barraclough 1997). Most Camillidae are associated with small mammal nests and burrows but the biology of *C. atrimana* is unknown; it is unlikely to be of any economic significance and potential ecological impacts cannot be determined until more information about its biology and New World distribution is known. Suction trapping appears to be an effective method of collecting some acalyptrate Diptera groups that are generally under-recorded by standard sampling techniques (e.g., some Anthomyzidae). Whether this accounts for the lack of previous records of *C. atrimana* from the New World, or if this Palaearctic species only recently became established in the Nearctic region is unknown.

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FIRST RECORD OF THE ORIENTAL CHESTNUT GALL WASP, *DRYOCOSMUS KURIPHILUS* YASUMATSU (HYMENOPTERA: CYNIPIDAE), IN CANADA

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Scientific Note *J. ent. Soc. Ont.* 143 : 125–128

The Oriental Chestnut Gall Wasp, *Dryocosmus kuriphilus* Yasumatsu (Hymenoptera: Cynipidae), originally from China, has become established in several other Asian countries, the USA, and Europe where it is parasitized by various species of Chalcidoidea that normally exploit oak gall wasps (Aebi et al. 2007). In the USA, *D. kuriphilus* was first recorded in 1974 and has been found in 10 states as far north as Pennsylvania and Ohio, on two Nearctic species of *Castanea*: *C. dentata* (Marshall) Borkhausen, and *C. pumila* Miller (Dixon et al. 1986; Anagnostakis 1997; Warmund 2009). Viggiani and Nugnes (2010) described and illustrated the larva. Numerous other Nearctic species are assigned to *Dryocosmus* (Burks 1979), the most recently described on *Chrysolepis* spp. (Buffington and Morita 2009).

We record for the first time the presence of *D. kuriphilus* in Canada and illustrate the adult and leaves with galls (Figs. 1–9). The galls (Figs. 8, 9) on a Chinese chestnut tree, *C. mollissima* Blume, had been collected in Niagara-on-the-Lake and submitted for identification to the National Identification Service, Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa (CNC). The twigs were placed in a rearing cage and one *Dryocosmus* specimen eventually emerged. Because no identified material of this species for comparison was in the CNC and there is no North American key to species of *Dryocosmus* they could only be tentatively identified by us as *D. kuriphilus*. Photographs were sent for identification to a specialist in Hungary and he confirmed that the genus was correct, and the species was almost certainly *D. kuriphilus*. The actual specimen was sent to a specialist in USA who confirmed that it is indeed this species. Another specimen, a species of *Torymus* (Hymenoptera: Torymidae), was found crawling about on the **outside** of the rearing cage and was collected. Presumably, it also emerged from the galls and found its way out of the cage (which had a narrow gap at the top) but there is a faint possibility that it came through an open window from elsewhere and not from the *D. kuriphilus* galls. Photographs of the *Torymus* (Figs. 10–17) were sent to a specialist in Czech Republic and he identified the species as the widespread, polyphagous species, *T. tubicola* (Osten Sacken) (Hymenoptera: Torymidae).

Material examined. CANADA: ON, Niagara on the Lake, 21.vi.2012 (galls collected), 9.vii.2012 (cynipid emerged), A. Harnden, ex *Castanea mollissima* (1♀, CNC). Torymidae: likely same data but collected in mid July (1♀, CNC).

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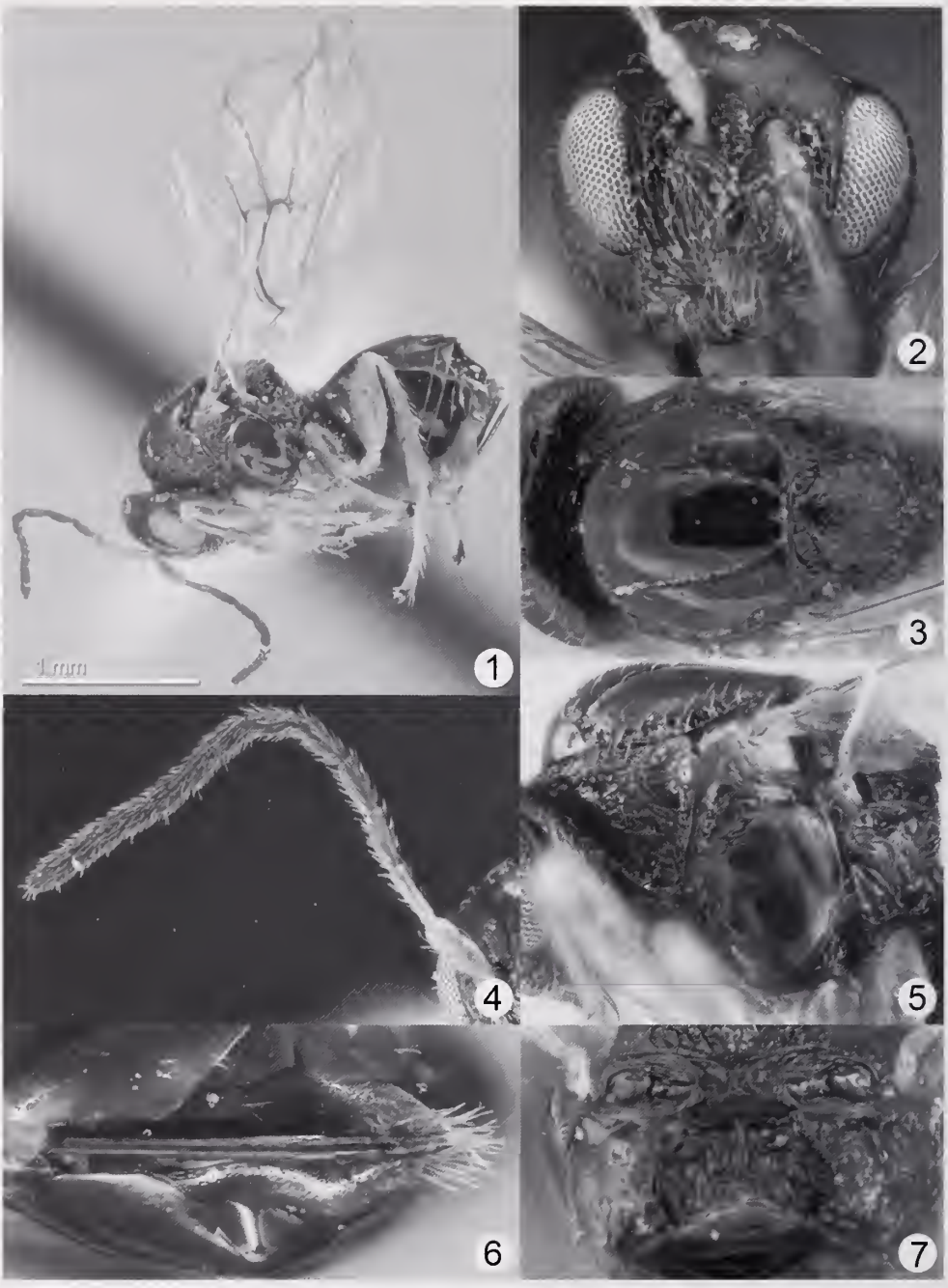
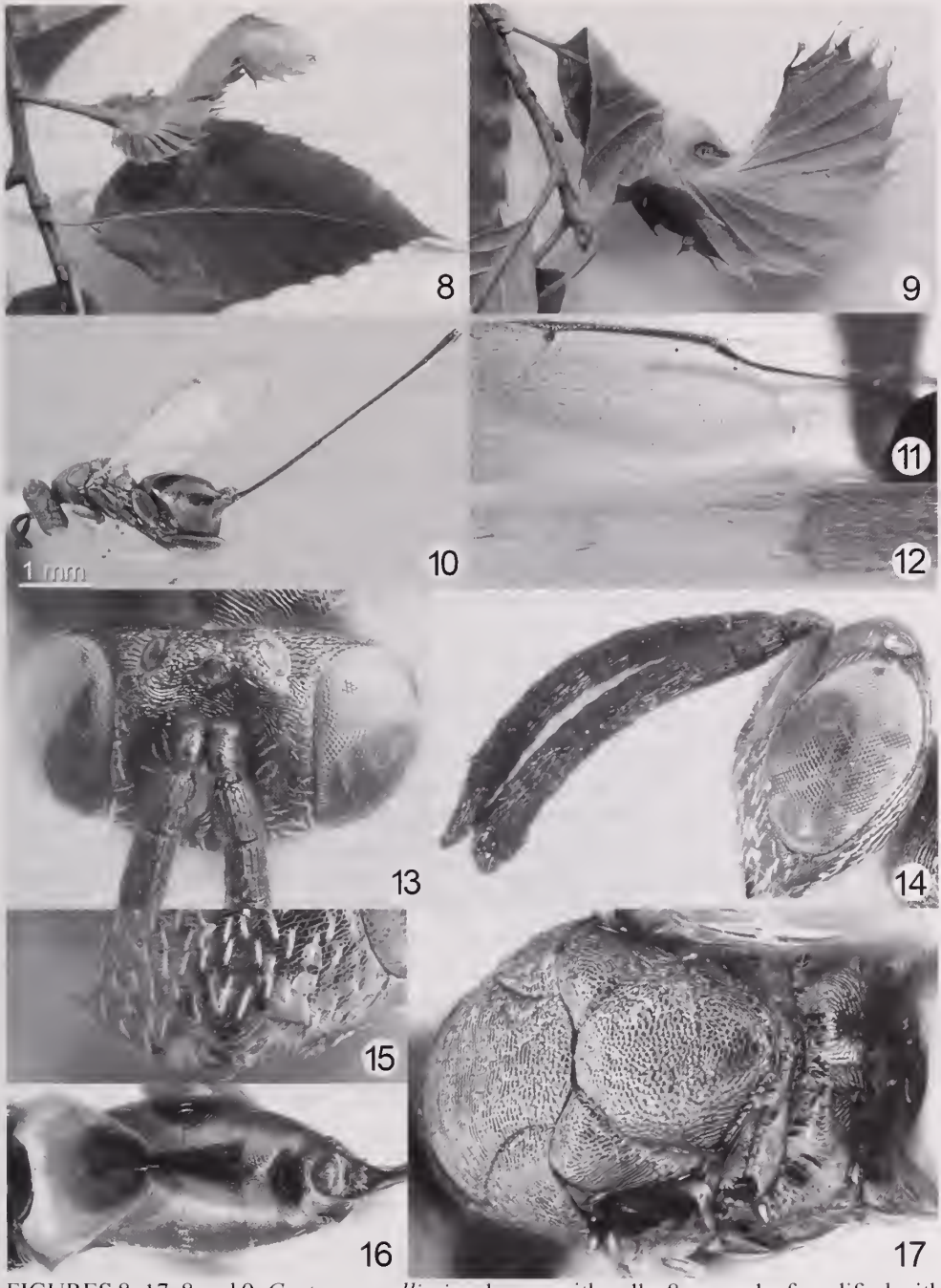


FIGURES 1–7. *Dryocosmus kuriphilus*. 1, habitus, lateral; 2, head, anterior; 3, mesosoma, dorsal; 4, antenna; 5, mesosoma, lateral; 6, ovipositor, ventral; 7, propodeum, dorsal.



FIGURES 8–17. 8 and 9, *Castanea mollissima* leaves with galls. 8, upper leaf modified with gall; lower leaf normal. 9, deformed leaf with gall. 10–17, *Torymus tubicola*. 10, habitus, lateral; 11, fore wing venation; 12, tibial spurs and basitarsus; 13, head, dorsal; 14, head and antennae, lateral; 15, clypeus; 16, metasoma, dorsal; 17, mesosoma, posterodorsal.

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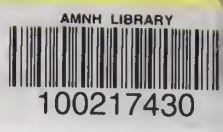

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